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14. Abstract

The development and widespread distribution of the low-cost, reliable, general purpose microcomputer has radically influenced expectations of the scope and economics of computer applications in information work.

The speakers in this Lecture Series draw on a wide range of practical experience to present studies of what is now realistic, and will examine current research and development as a guide to the techniques which will be important and the opportunities which will arise in the near future.

This Lecture Series, sponsored by the Technical Information Panel of AGARD, has been implemented by the Consultant and Exchange Programme of AGARD.

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AGARD Lecture Series No.149

THE APPLICATION OF MICROCOMPUTERS TO AEROSPACE AND DEFENCE SCIENTIFIC AND TECHNICAL INFORMATION WORK

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Introduction & Overview

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Summary

In 1978 the theme of Lecture Series 92 was the opportunity offered in automation of library and information services by cheaper, faster minicomputer equipment, and new database and applications software. Speakers addressed the feasibility of automation; the techniques for the necessary systems studies; and cost effectiveness in units of tens of man years of programming and equipment costing $100,000 or more.

There is now a radical change in what an information specialist may reasonably expect, due largely to the development of the low cost, reliable, general purpose microcomputer. Investments may start as small as $2,000 for a simple word processor or $20,000 for a package of software and hardware which will serve a small library. Software is being written for many tasks, and the best is of high quality and well documented.

The speakers in this lecture series report the growing role of the micro-computer in cataloguing and library housekeeping; in accessing shared information resources through local and wide networks; and in new approaches to information management and retrieval.

Developing awareness

The scope of scientific and technical information work is wide, and depends on many skills in creating, validating, organising and distributing textual, numeric and graphic material in a variety of forms to many diverse users. The use of computers to support these processes has developed more and more rapidly from small beginnings in the 1960's, until nowadays it requires some effort to envisage such information systems - at least for english language material, and in developed countries - without such an electronic infrastructure. Setting aside, for later papers, questions of languages and state of technological development, it seems only reasonable to survey, if not fully to explain, how such a narrow aspect of technology as the general purpose microcomputer has come to be so significant a component of the information specialist's resources. A start may be made through a series of 'snapshots' of what was going on at a few sampling points in the last decade.

The present lecture series is a lineal descendent of TIP LS 92, held in Delft and Ankara in 1978, on the application of low cost minicomputers to library work (1). The central theme was the new opportunity then offered in the automation of library and information services by cheaper, faster equipment, and the developing range of database and applications software products. Speakers were concerned with the feasibility of library automation; with the technical methodology of the necessary systems studies; with application of 'database' technology to library processes; and with cost effectiveness measured in units of tens of man-years of programming effort and equipment investments of $100,000 and more. The papers are still of value - perhaps the case studies in particular - as many of the problems identified with information quality and with project control during innovation are still with us. On the other hand, the practicality of computer application in libraries is now taken for granted, and the effectiveness of using database and other 'package' software to control costs and minimise development time scales is widely recognised.

A sample of papers published in **program** during the same year (2), shows that most systems reported in this UK based journal were still custom built, although there is an account of the ASSASSIN retrieval package, a short paper on 'Text processing', and a review of a text book on BASIC which regards both that language and microcomputers as having some potential for library use.

By the time of the TIP Meeting in Munich, in 1981 (3), there was no doubt in the minds of the speakers - nor of most of the audience - of the feasibility and desirability of applying computer based methods in information work. Telecommunications, and the use of minicomputers as well as mainframes in establishing networks of shared resources, were identified as important areas of innovation, and graphic presentation in a variety of forms was discussed and demontrated. At the same time, however, 'small computers and cheap software' still meant minicomputers and substantial investment in package software or major costs of special program development.

The present writer devoted two pessimistic paragraphs to the lack of design and poor quality of implementation of microcomputer software being written for information work - still predominantly 'one off' initiatives at that time. The **Journal of Library Automation** (4) for 1981, which is mainly concerned with North American material, contains one paper on the application of an Apple II microcomputer in 'backup' of a CLSI system; two references to microcomputers as intelligent terminals; and a reference to their potential for single user circulation control systems.

By 1985, in contrast, just two quarterly issues of the same journal (now renamed **Information Technology and Libraries**) contain no fewer than twelve significant references to microcomputers in library and information work. The most recent two issues of **program** (excluding the April 1986 special issue on Online Public Access Catalogues) contain fourteen similar references to microcomputer applications, of which three were British Library sponsored research projects. The new journal **Electronic Library** (5) has in the December 1985 issue a total of six out of eight main articles relating to microcomputer applications, including an extended review of hardware developments.

So much for the growth of microcomputer **awareness** among information users; the underlying developments involved hardware, software and user needs and expectations.

Changes in small computers

During the last decade the 'microcomputer' has reduced by a factor of ten or more the real cost of single user computing. It has also, and these are less spectacular changes but probably at least as important, made low cost local area networks feasible, transformed the document creation tasks of most organisations through word processing and electronic mail, and altered the balance between mainframes, minicomputers and distributed function systems, but it is the **discontinuity** in the real economics of computing which is most remarkable.

In purely technological terms, it is perhaps least obviously abrupt - for microprocessors have been around since the development of 'large scale integration' in chip fabrication in the early 1970s. These microprocessors were built-in to special purpose systems, input-output controllers, real time data loggers, subsidiary parts of minicomputers and communications equipment. Operating systems were, by minicomputer standards, primitive, and much software was written in assembly language and supplied in read only hardware (ROM) form. As chip fabrication went into high volume - and the markets for digital watches and calculators have been seen by some commentators to have been the true stimulus - microprocessors became so cheap in lots of a few hundred of a type, that they became realistic components of electronic hardware built in hundreds or thousands rather than tens.

For five years from 1975, the main application areas were in 'intelligent' display terminals, to offer local increase in facilities; peripheral equipment and communications controllers, taking load off central processors; word processors of all sorts; and a steadily increasing but less visible extension of the 'special device' market. Memory devices, both solid state (RAM) and disc based (floppies) evolved to meet the new demands, and it became reasonable to look for a free standing word processor, or a 'small business computer' at a price of about two years' salary for the operator, although programming was still either difficult and costly, in assembler, or inefficient in high level 'interpreter' languages. BASIC, an unaesthetic but easily learned programming language, had been slowly spreading for some years, and more and more young scientists and technologists were coming to regard computer access not as a costly and arcane discipline best confined to Computer Centres and similar reservations, but as a normal service in their work, and occasionally in their leisure. In retrospect, it can be seen, although it was not nearly so obvious at the time, that conditions were right for change.

What actually happened around 1980 is still the subject of some contention, mainly because the experience of those involved in North America, in UK, in Japan and in Europe depended on the different balance of developments in those areas. Very roughly, one may characterise the US initiatives as business use centred, Japanese as a response to the opportunities offered to their existing highly skilled electronics producers, the United Kingdom driven by the 'personal' or 'home' micro surge, and other European countries - certainly France, Germany and the Netherlands - as slower to join in, but perhaps more balanced when they did so. The cost of a single user computer, with its own storage for data, a simple printer and a display of tolerable quality fell rapidly as shipment volumes of individual models went into tens of thousands per year, until the entry cost of a 'personal' micro at the minimum useful level is now about $120, a disc based system can be had for $400 and a system powerful enough for a small business for $3,500 - and these prices are daily being attacked by new

entrants and new models. It is useful to distinguish some categories of system, if only to exclude those less likely to be relevant to the information specialist, except perhaps as entertainment or educational items :

- Games computers; cheap, limited in scope, and mainly used for the playing of video games which range from fairly crude to some approach to 'arcade' quality of presentation;

- Simulators and training aids running on personal micros and small business machines - note that these are special purpose devices in the sense that the user is not expected to do any programming work;

- Arcade games; special purpose, high performance games, with visual presentation ranging up to high quality and imaginative graphics, and incorporating multiple skill levels, evolving difficulty and training modes in some cases;

None of these is directly useful to information specialists, but the effect on users' expectation of presentation quality has been very important - the 'glass teletype' display is unexciting compared with a graphics game!

- Personal computers; used here to mean small, sometimes portable, machines, sometimes complete in themselves, but often needing an auxiliary 'TV' like display, and storing non-transient data and programs on cassette tape; the larger models have 'floppy discs' of 400k bytes to 1.2Mb (million bytes) for interactive storage; BASIC, in a number of dialects and variations is probably still the dominant development language; such machines are intended to be programmed by the user, and 'learning about IT' is often cited as the main reason for purchase;

- Business micros; substantial microcomputer systems, with memory typically in the range of 256k 'bytes' or characters to 2Mb or more, and magnetic 'hard' disc storage of 5 to 20Mb; a wide range of development languages and applications packages, but still restricted in the operating systems available;

- Small minicomputers; overlapping with the business micros, but bringing from the minicomputer range proper more powerful operating systems, multiuser and networking facilities, and some well established and reliable software 'packages' first developed for larger configurations.

It is the last three categories which most affect library and information centre practice. The personal computers may be useful in themselves, especially as word processors and for spreadsheets and simple accounting work, but are also likely to be applied as intelligent terminals for access to online databases and for electronic mail. They are normally 'single user', one application at a time, configurations, but may be connected in multiuser networks on a limited scale.

Business computers are dominated (numerically at least) by the IBM-pc range and its imitators, although vendors like Amstrad, Apple, Apricot and Atari (among others) have significant market penetration and alternative approaches to both hardware and operating systems. At one end of the scale one finds IBM-pc XT machines still running single-user, single application at a time systems, but now with 10Mb hard disc storage; at the other extreme, systems like the Fortune range offer multiuser operating systems, and disc storage in the 40Mb range or more. Networks, both local and widespread, are readily implemented on machines in this group.

The small minicomputers - and the Digital Equipment (DEC) PDP 11/24 from an earlier generation, MicroVAX II in the current range are typical examples - differ from the larger business micros more in the availability of pre-existing software and highly developed operating systems than in speed of processors or size of memory, and the distinction will become less important as the surviving business micros gather large software libraries.

Peripheral equipment - printers, keyboards, modems, display screens - follows similar paths of decreasing real cost and increasing capability. Details will emerge from the later papers in this Lecture Series, but consider only one example, that this paper was prepared on a one million byte computer, took up 40,000 characters of disc space without significant impact on overall storage usage, and was output on a laser printer, using a 'book' fount, at a resolution of rather better than 200 points per inch - and the whole configuration, including software, might have been purchased for under $10,000. (The largest unit, the LaserWriter, was hired for the occasion!)

Changes in software

Compared with the position in 1978, software for information specialists is wider in scope, lower in price, and (the best of it) more reliable, more efficient, and easier to use.

These changes have been achieved, at least in part, through increasing willingness to cooperate in development and to buy ready made 'package' systems, rather than writing local or special programmes for each application. In 1975, the authors of the COLA Report (6) had difficulty in finding even one or two examples of cooperative or shared development; in 1978 (7), one of them was still having to argue the financial and technical realism of 'buying' rather than 'making' software. By the Munich TIP Meeting, in 1981 (3), six out of twelve speakers take the availability of standard 'package' software for granted, and most of the others accept the value of shared, if special purpose, database systems. The 1986 directories of microcomputer software for libraries and information centres now list over 250 programs or packages commercially available in UK including more than one hundred intended especially for text storage and retrieval (8, 9). In North America, certainly for microcomputers, there are even more.

For microcomputers in general, the change in scale of the potential market place for software from tens or hundreds of sales being 'success' to tens of thousands being not uncommon attracted cohorts of entrepreneurs and made many institutions look hard at their 'in house' products as potential money earners. Prices of software packages fell dramatically, both in response to mass marketing and competitive pressures, and also because of a strong if not wholly rational feeling that a reasonable price to pay for a piece of software was 10-50% of the cost of the machine it would run on. Some of the successes - VISICALC, WORDSTAR, dBase II, for example - are, if not quite household words, at least openly discussed on public transport by high school pupils!

From an information service standpoint, two threads may be separated. Firstly, there is the distinction between software specially conceived for information storage, retrieval or publishing, with a view to its use in a library or information centre context - as opposed to the adaptation of more general purpose software for library directed purposes. Issue control and reservations management systems, for example, are usually so exotic a form of production control as to justify software specifically conceived for the purpose, even if standard database or file handling utilities are incorporated. The tasks of cataloguing large collections or creating bibliographic files with extended detailed entries may similarly call for special purpose systems, but many smaller applications - especially for accession lists and other current awareness services - are successfully operated on standard word processing software, or on simple, general purpose file handlers like CARDBOX and dBase II. In general, special purpose software is likely to be more expensive per useful function (smaller market); more directly applicable (if it fits) and more obviously unsuitable (if it does not fit); easier for an information specialist to learn and exploit, but less flexible for unforseen applications, than adapted general purpose package systems. In any particular case, it may be the quality of documentation which is actually the critical factor, although the effect of selling large numbers of low cost software products has been to force the computer industry (at last) to take proper presentation and training material, and freedom from faults in the product, adequately seriously.

The second case distinguishes between software developed since micro computers became cheap and widespread, and so exploiting directly the special features of that environment, and systems which were originally designed for mainframes or minicomputers, and subsequently adapted to run on micros. The success of software developers in doing conversions of this class has in some cases been surprisingly good. In the field of free text retrieval software alone, ASSASSIN (ICI Ltd), BASIS (Battelle Laboratories), CAIRS (Food Industry RA), SEARCH (Bibliographic Retrieval Services Inc.) and STATUS (AERE Harwell Laboratories) - all of which are well established, powerful systems with a wide range of features - have been successfully transferred to microcomputers with very little loss of scope. Limitations have been more from the operating system, such as single user only on IBM pc series, and in handling disc storage in excess of 60 million characters.

Software developed for the first time in the micro environment often shows one or more of the following characteristics, and this applies equally to general purpose and information centre specific products:

- Portability across widely used operating systems - the main groups are CPM, MS-DOS and UNIX and their variants;
- Compatibility of programming language across a wide range of machines - BASIC is probably most widespread (in spite of numerous short comings for serious software); COBOL and FORTRAN, especially for the larger micro; 'C' under UNIX; and PASCAL and FORTH on a smaller scale;
- Use of graphics of all sorts, sometimes of colour, and increasingly of icon-based presentation of system functions as a symbolic alternative to menus or command line input;

- Free use of processor capacity during interactive sessions - when the power of the micro is usually very much under used - to make systems more supportive of the user and to provide adaptive 'help' and tutorial features.

Rather more negatively, one may also expect, in some cases:

- A tendency to leave backup of critical data files to the discretion (and patience) of the user - or its complement, a disinclination to include the cost of realistic 'dumping' devices in sales proposals;

- Prolonged waits for the program faults which do appear to be corrected - 'fixed in the next version' is a characteristic state;

- No more support or training than the user pays for - because at the prices charged for micro computer software there is little margin of profit for any supporting services.

The last point applies also to packages converted from minicomputer versions, because the price charged for the first copy may have fallen from $30,000 to $1,500 in the process.

One other trend which is of interest is the apparent swing from library cataloguing and housekeeping system investment predominant in the late 1970s, to a mix in which the larger component now appears to be text storage and retrieval applications. Firm data is difficult to collect, but at least for the United Kingdom, for mainframe and minicomputer based systems, there is some material (10,11 and personal communications). In UK in 1985, there were estimated to be:

- 90 public libraries with 'package' issue systems of some sort; (Plessey, ALS, GEAC, SB Electronics, & others);

- An unknown number - maybe about 20 - of academic libraries using similar issue management systems - note that many academic libraries wrote 'own design' systems using institutional computer services;

- 190 libraries (all classes) using cooperative cataloguing sources; (BLCMP, BLAISE/LOCAS, OCLC, SCOLCAP, SWALCAP etc.);

- 25 or so other users of similar package systems for cataloguing or housekeeping outside the standard groups of academic and public libraries;

This gives a rough total count of 325 systems in 275 libraries using packages in the cataloguing and housekeeping classes.

A count of mainframe and minicomputer users of the main free text software packages in UK (ASSASSIN, BASIS, CAIRS, INFOText, SEARCH, STAIRS, STATUS and at least six other less widespread products) gives a total in excess of 350, and the rate of growth is at least 30% per year. (STAIRS may have been underestimated - IBM are reticent about their sales performance.) In view of the results of the market study made in 1978 to 1979 on behalf of AERE Harwell Laboratories (12), when general awareness of the potential for use of free text package systes was negligible, and even IBM's main product was almost unknown to computer managers, this represents a considerable change of position.

Changes in the user's expectations

One is tempted to say that, in view of the ill conceived, poorly documented and unreliable systems which proliferated for a few years in the early 1980s, users should have learned not to expect too much, but the poor software products and weak hardware designs are being eliminated by market competition and improved awareness of what can be achieved by good practice. The following summary deals only with system products as they should be, and as, in an increasing number of cases, they are.

It is now reasonable to expect that a software product from a reputable supplier, to run on a sound micro computer, can be installed and used without either a prolonged struggle with the instructions, or falling foul of bugs in the programs. The documentation is likely to describe the product adequately - often well - and will incorporate training material, samples of set up and use, and suggestions on how to get best performance. The Apple Macintosh documentation is an example of how well this can be done. The user - encouraged by games and specific application software - is also likely to demand that any package as supplied is reliable, robust, as easy to use as is consistent with its functional scope, and sensibly designed for the tasks towards which it is

directed. The need to make the point that software, as delivered, nowadays often works as specified, is a sad comment on the performance of many developers in the computer industry from the beginnings up to 1980.

Libraries and Information Centres are coming under increasing pressure from **their** users to deliver 'facts' as much as to indicate where in the literature the desired information may be found. This trend is particularly noticeable with computer based services, where the contrast between a numeric database which delivers 'answers', and a bibliographic database which provides a list of references is most obvious. Online services such as World Reporter and the new British Telecom HOTLINE set out to offer for textual material, the same sort of facility that is available for stock market and exchange data on DATASTREAM and PRESTEL. Airline and other timetables and tariffs are a developing service on the electronic mail networks such as Telecom Gold. On micro computer text database systems may be found an increasing number of applications such as current correspondence files, personal records, inspection records, technical data sheets which meet this requirement for 'a single place to look for an answer'. Communications networks add to the potential for development of such 'fact' services.

Finally - and perhaps with greatest effect on the way in which information services will develop - consider the widespread expectation, often justified by experience, that a micro computer, its operating system, magnetic disc storage, printer and applications software may be purchased, installed and brought into productive use for a sum of money less than one year's salary for a junior qualified employee. This leads to the substitution of systems for routine work, and should, in principle, free skilled staff from routine tasks to apply their time and ability to the new, the difficult and (it is to hoped) the more interesting parts of the range of information management tasks (13).

Structure of the Lecture Series

This Lecture Series will develop many of the ideas introduced above, and is intended to present a current and comprehensive review of where we are in a rapidly changing scene, and, so far as possible, a view of what topics are going to matter most in the next few years. It is grouped around three 'themes', which may be thought of as local systems, resource sharing systems, and technical development trends for the future.

On the first theme, there are papers which review the overall scope of library 'housekeeping' in the wide sense (Paul Burton) and a case study in cataloguing making extensive use of a micro computer system (Cathy Murphy). Mel Collier then develops the topic of local area network and electronic office techniques in the library, which bridges between local and shared resource systems.

Resource sharing in bibliographic and related networks - microcomputers as part of large scale systems - opens the second theme (Richard Hartt), and the growing emphasis on 'fact' delivery systems from shared resource networks is a main topic of the two papers on microcomputers applied in data and text retrieval.

Two accounts of research and development topics in the field, application of artificial intelligence (Ian Croall) and software strategy (John Ashford) set out to establish the 'what next?' theme, with some examples of what has been done so far in practice. Here the speakers consider also some developments outside the library and information field, where - as in office automation - traditional demarcations are being revised, and software initiatives are being taken which are potentially important to this audience.

Paul Burton completes the formal presentions with a paper on the tasks of procurement and management of micro computer based systems, which must be performed well if development plans are to succeed.

The closing 'round table' discussion is seen as an important part of the lecture series. During the meeting, those attending will be invited to submit questions, comments and points of argument, and it is planned to structure the discussion around this material. All of the speakers will be available and a summary of contributions from all participants in the discussions will be attempted for incorporation in the final proceedings.

References

1 *The application of inexpensive minicomputers to information work.* AGARD Lecture Series LS92. AGARD, Neuilly-sur-Seine, 1978

2 **program** - is published in four issues each year by Aslib, London

3 *What should users expect from information storage and retrieval systems of the 1980's?* AGARD Conference Proceedings No. 304, Munich 1981. AGARD, Neuilly-sur-Seine, 1981

4 **Journal of Library Information** *now* **Information Technology and Libraries** is published quarterly by The American Library Association, Chicago, Ill.

5 **Electronic Library** - is published four times per year by Learned Information, Abingdon, Oxon. UK

6 J H Ashford, R M Bourne and J M Plaister. *Cooperation in library automation.* (OSTI Report No. 5225), London, LASER, 1975

7 J H Ashford. Cost effectiveness in library automation. *(in) reference 1.*

8 H Gates. A directory of library and information retrieval software for microcomputers. Gower, Aldershot and Brookfield, Va, 1985

9 R Kimberley et al. *Text retrieval - a directory of software.* (IIS Southern Branch) Gower, Aldershot and Brookfield, Va, 1985 and *Supplement* 1986

10 **VINE** No. 52 - published by the Information Technology Centre, London, supported by the British Library

11 **VINE** No. 54

12 J H Ashford and D I Matkin. Report of a study of the potential users and application areas for free text information storage and retrieval systems in Britain. Program, Vol.14 No. 1, January 1980

13 J Gurnsey. *The information profession in the electronic age.* London, Clive Bingley, 1985.

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APPLICATIONS IN LIBRARY MANAGEMENT, REQUISITIONS, LOANS AND STOCK CONTROL

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That the microcomputer has provided numerous libraries and information services (LIS) with an opportunity to automate routines which was previously denied to them because of their size and (usually) their lack of funding, has now achieved the status of a cliche. Like most cliches, however, it contains more than a grain of truth. Plummeting costs of hardware coupled with increasing sophistication and power of software (albeit at increased prices) mean that all but the smallest LIS can now contemplate automation of most routines, including that cluster of applications which is referred to as "housekeeping". Indeed, it could be said that these smaller LIS are most able to benefit from computer-based automation, since they are being faced with increasing demands upon their services, demands which have to be met with low (and sometimes reducing) staffing levels. Despite this, the take-up rate of microcomputers has not been high, though there are signs that it is increasing steadily. This can be explained in part by the restrictions on funding which these LIS have faced (in common with all others), but it has to be said that there remains a certain lack of awareness among some LIS managers. Evidence for this has come from some of the surveys of microcomputer-based applications, which report, for example, LIS managers who claim that their stock of 15,000 volumes, 350 journals and loan rates of several hundred per week do not justify a computer-based system!

Nevertheless, growing number of LIS managers are implementing microcomputers for housekeeping applications, including management tasks, acquisitions, circulation control and aspects of stock management. These rank alongside the other applications, such as cataloguing and information retrieval, which are considered by other speakers.

The housekeeping operations of an LIS can be broadly divided into those which relate to the office and management aspects of the LIS, together with the more specific (and often unique) routines such as circulation control and acquisitions.

THE MICROCOMPUTER AND LIS MANAGEMENT

The application of the microcomputer to the "business" aspects of LIS management was one of the first and most popular uses. There are many reasons why this was so, not least the fact that, once the initial learning period has been passed, it is relatively easily to begin using the microcomputer for word processing, spreadsheet analyses, statistics, and so on. Unlike online catalogues, circulation control or in-house databases, these applications do not require the prior establishment of large files of records: LIS staff can begin to use a word processor immediately. These applications were also already tried and tested in the business world, and there was a large user base for the more popular software to which LIS managers could turn for advice.

While the obvious housekeeping applications of the microcomputer extend to word processing, spreadsheets, etc., the professional literature contains a number of reports of novel uses of the microcomputer, some of which are discussed below.

Within the LIS, word processors can, of course, carry out all the tasks for which they are so widely used in other organisations. Standard documents and letters can be maintained and printed with minor changes to make them more personal, while letters can be addressed automatically using mailmerge facilities working with files of names and addresses. In addition, draft documents can be prepared and edited to produce perfect copy and regularly-used documents can be stored and amended at intervals to produce up-to-date versions with the minimum of re-typing.

In addition, there are the typical LIS applications such as the production and maintenance of reading lists on specific topics, which can be made easier with word processor. Once the initial file has been created, it is a simple matter to update it as required and to re-issue a printed version. If the records for such lists can be derived from existing machine-readable records, such as an online catalogue, then the task is still easier. One university library now prepares such reading lists as a matter of course[1].
A related application is the production of lists or indexes to special collections of material which are augmented frequently. One polytechnic library maintains an index to its collection of video tapes using a word processor. New additions are made regularly and old material is withdrawn, but revised indexes are simple to produce, and indeed, the library has been able to increase the frequency with which it issues the index.

Word processors generally provide no search facilities (beyond that of the search and replace variety), so their use in some files is limited. LIS, therefore, can and do make considerable use of database management (DBMS) or file handling software to create and maintain various files for information retrieval. DBMS and file handlers provide facilities for designing record structures, storing records and for retrieving them in response to specific enquiries from users. The power of such programs (and there are many hundreds of them available for practically every make of microcomputer) vary considerably, from the ability to handle a few hundred small records to those which can store and retrieve thousands of records with numerous fields, free text (for abstracts) and so on. These programs have been adopted by a large number of LIS for a wide variety of applications, ranging from indexes to journal articles, through serials control and the maintenance of short loan collections, to large-scale databases. There are numerous reports in the professional literature about the use of such packages [2,3,4], among which dBase II figures prominently, and there seems little doubt that they provided many LIS staff with their first taste of microcomputer-based information retrieval.

Since the early days, DBMS have increased in power and sophistication to the extent that they can handle many LIS applications, and a variety of "offshoots" have arisen which are aimed specifically at the LIS market. A number of these have been derived from the original mainframe versions, and there are reports of programs like MicroCairs in use in LIS[5].

Spreadsheets or financial modelling packages have been used by a number of LIS in various ways. The most obvious use is in the recording of budgetary details[6], making it easier for LIS to keep track of spending and the amounts left for purchases. These packages can, however, also be used for modelling many aspects of the LIS.

For example, the University of Sussex used the Ultracalc program on a BBC micro to plan its re-shelving exercise. Using the spreadsheet allowed the staff to provide for differing growth rates in individual areas of the library, and thus to ensure that optimum use was made of the available shelving[7].

Spreadsheets provide the ability to speculate and to predict future developments and patterns in various areas of the LIS, because they are built up using equations, formulae, etc. to manipulate the data which the LIS staff enter. Clark, for example, provides spreadsheet models for library use which will "predict" the additional number of journals and monographs required to match an increase in student numbers at various educational levels[8]. These "what-if" calculations are a feature of the spreadsheet or financial modelling package and indicate that the use of such programs is not restricted to financial work alone. Of course, the results of a "what-if" calculation will only be as good as the data and formulae on which it is based, but it is possible to add new or more accurate data as it becomes available.

Spreadsheets can also be used for many statistical calculations and thus can replace the specialised statistical packages which are also available. Provided that the LIS manager knows the relevant formula (and the significance of the technique!), the spreadsheet can be completed with the data gathered from surveys, studies, etc. and will carry out the calculations automatically - and, in most cases, in the blink of an eye! Clark has also provided models for calculating measures of central tendency, standard deviation, regression analysis, correlation and frequency distributions, together with many other techniques of value in user surveys and general statistical presentations. In this context, it is worth noting the presence of a number of programs designed to produce graphical presentations such as bar and column charts, frequency polygons, pie charts and other pictorial methods of presenting data. These normally require the LIS manager to derive the data first, but once these data are input to the program, he can choose between a variety of presentations which are then drawn automatically, with the appropriate shading, keys, etc.

For some time after the spread of the microcomputer, anyone wishing to use packages such as word processors, DBMS, spreadsheets and/or statistics had to make do with three or more different programs, each with its own method of operation. In the last two to three years, however, a new "generation" of business software has been developed, known as the integrated package. This contains all three programs in one (i.e., word processor, DBMS and spreadsheet), and each program can access and use the data or information contained by one of the others. Early versions of such software were criticised as being low-power versions of the "stand-alone" type, but this is no longer the case, and contemporary packages offer flexibility, power and sophistication. It is thus possible, for example, to prepare a document using the word processor, and to incorporate figures from the spreadsheet, without leaving the first program. DBMS records can be similarly added to the word processor. Using a package like Symphony or Framework, for example, means that the LIS manager can prepare the annual report and incorporate tables or graphical illustrations with great ease. Programs like this have yet to penetrate the LIS world to any great depth, although the University of Arkansas uses Lotus 1-2-3 to maintain a file of information on online databases which indicates themost suitable database to search for a given enquiry[9].

So far, we have only considered the use of microcomputers for the typical management and administrative functions of the LIS, and indicated the suitability of standard business software. However, LIS staff have known to use to develop systems of some novelty and imagination on microcomputers. Though these are largely "one-off" applications developed for a particular library, there is no reason why they should not be adopted as examples for use by others. The re-shelving exercise at Sussex University was cited earlier, and to it we can add examples such as the use of PFS:File and PFS:Report at Arizona State University Library. Here, they used the software to build up a profile of teaching, research and professional interests which can be consulted by library subject specialists who seek to direct new information to the appropriate staff. The new, microcomputer-based system is much more flexible than the earlier, card-based file, since it provides more access points[10].

On a very simple (but useful) level, two libraries have reported the use of Apple systems to produce a range of signs for guiding, information and instruction. In one instance, the MacPaint package is used to design , on screen, a variety of instructional and guiding signs using a range of fonts for lettering, plus shading and patterns for the graphics. The resulting signs can be stored on disk for future use and/or printed and copied[11]. An American preparatory school uses an Apple IIe to produce a variety of promotional literature, greetings cards and invitations - a simple idea, but one which augments the image of the LIS in the eyes of users[12].

THE MICROCOMPUTER AND LIS HOUSEKEEPING: ACQUISITIONS, LOANS AND STOCK CONTROL

Libraries and information services have reported applications of the microcomputer for every conceivable LIS operation, it seems, and there is a rapidly growing range of software from which to choose. This section will concentrate on three such applications which constitute a major portion of that work known as "LIS housekeeping".

Acquisition of stock is an application which has been neglected to a certain extent, although it is an ideal candidate for microcomputer-based systems. Much of the data which are used in the acquisitions process is duplicated at some stage: details of author, title, publisher, supplier, etc. may appear on record cards, the official order form, claims for overdue titles and on a version which is placed in the catalogue to indicate a title on order. Previously, much use was made ofmulti-part order slips, in recognition of this fact.

DBMS software such as dBase II offers a simple way to automate the acquisitions process, since each title to be ordered can be recorded and then used in various ways to suit the needs of the LIS. Precisely what information is recorded will depend on an analysis of the acquisitions process, which will indicate the record structure required. Relevant titles can be chosen from the standard sources and stored until an order can be sent to a supplier. Most contemporary DBMS or file handlers provide a report generator which means that the basic records can be printed in various alternate versions and layouts, so it is possible, for example, to include only those parts of a record which are of interest to the supplier and to omit details such as fund debited, for whom the title has been ordered, etc. Records can be retrieved and printed as orders to a supplier, while the file remains as a record of titles on order, so that the usual enquiries from users can be answered, overdue titles can be claimed, and so on.

Since many DBMS include rudimentary mathematical operations, it is also possible to calculate totals for individual orders, to maintain an account of the amount committed to books on order, or to calcuate the spending of departments, sections, etc.

A significant development of the last few years has been the production of integrated LIS software which contains a number of modules, each of which can be purchased separately if necessary. These modules work on the principle of eliminating duplication of effort as far as possible, and to do this they utilise the same basic record in various ways. Thus, the online catalogue record can also serve, perhaps in abbreviated form, as a circulation record. In this approach, acquisitions has, in some cases, been taken as the obvious starting point for file creation. Logical Choice's Bookshelf software, for example, contains modules for acquisitions, cataloguing, online catalogue and circulation control[13].

Details of titles ordered are added to the acquisitions module, which can also create a printed order. The record is available to anyone consulting the catalogue, thus indicating a title on order. The primary aim of the file, of course, is to record orders and acquisitions. The file can be searched by date for overdue items, and claims can be written automatically. On receipt of a title, there are procedures to assign accession numbers and bar codes, if required. The records of books received are amended accordingly, with date received, etc., and these amended records can be used to create accessions lists of recent additions.

Also significant is the fact that this record forms the basis of a cataloguing record, since it can be transferred to the cataloguing module and from thence to the online catalogue. In this way, duplication of keyboarding is reduced and only new data have to be added to the record. Pyramid's CALM package offers similar facilities[14], and further use of the amended record is made by the circulation control system. Indeed, in some of these integrated packages, the online catalogue and loans records are combined, since the system temporarily "modifies" the catalogue record to indicate its loan status (though not, of course, the borrower: this information is available only to the library staff). In the case of multiple copies of a title, the record indicates which copies are on loan.

The advantage of integrated software like this also lies in the uniform set of commands for each module, making it easier for staff and users to use the system. It brings closer the time when we can contemplate a single, unified LIS database of records for all materials and their current status (on order, on loan, etc.). To this end, some of the available systems also provide a serials management module which maintains records of journal holdings.

As was suggested earlier, one of the modules provided in integrated software is for circulation control which, as an application, also contains many aspects which make it suitable for automation. Essentially, two different approaches are possible using microcomputer-based systems. A straightforward absence file records only the loans themselves: a record contains details of the book borrowed, matched with details of the borrower. These details are entered at the time of the loan, and the record is deleted when the book is returned.

The alternative is to develop a bibliographic database of the stock, together with a file relating to borrowers (names, addresses, reader number, etc.). Book and borrower details are then matched at the time of the loan, normally by recording the reader's number against the bibliographic record. The software is capable of expanding the number into name and address, etc., so that notices contain more than just a number. A similar matching process occurs for the books borrowed, so that author, title, etc. are incorporated as needed.

In this way, it is possible to use numbers for speed and brevity, but to ensure that fuller details can be included when needed. Clearly, a bibliographically based circulation control system of this type has much in common with the catalogue, hence the link mentioned earlier.

The potentially large size of files involved in circulation control (and some other applications) almost certainly mean that a hard disk of some capacity will be required. As a rule of thumb for calculating the storage space required (for circulation control and online catalogues), 1,000 bibliographic records require a minimum of IMb -1.2Mb of storage.

The precise way in which details of book and borrower are entered are also important, and alternatives must be considered by the LIS manager. At the simplest level, a book number and a reader number at entered from the keyboard at the time of the loan: the file then contains only sets of those two numbers (together with return disk). This is undoubtedly the simplest method of operation, and requires little or no set-up time. However, any enquiries made of the system (for overdue items, reserved books, etc.) will only produce these numbers, which then require some means by which they can be "translated". This method is also subject to keyboarding errors and is probably only suitable for LIS with a very low loans rate.

Entry can be made easier by the use of bar codes, and many microcomputer systems are able to handle bar codes for reader and book numbers. The possibilities for circulation control, therefore, range from an absence file which is created from keyboarded details to a full-scale bibliographic record-based system using bar codes. The choice will depend on an analysis of the particular LIS's requirements, but various permutations are possible. Shorter set-up times may mean more time spent looking up details of books and readers, and larger LIS with a high rate of borrowing will almost certainly have to consider the alternatives, one of which includes a link with the online catalogue.

At the very simplest level, it is possible to consider the use of a DBMS package running on a microcomputer dedicated to circulation control, although a number of programs are now available for circulation control, most of which require the establishment of a bibliographic file. The packages also provide various facilities relating to the categories of loan items and borrowers. Different items may have differing loan periods, and an LIS may have various users who are entitled to different numbers of loans for varying periods. The Circulation Control System from Information System Design, for example, provides for 8 categories of borrower and of loan material. Like other packages, it will also produce standard notices for overdue items, as well as statistics on use. From these, the LIS manager can determine underused material[15].

G&G Software's CLASS software is in use at Harper Adams Agricultural College and is linked with an online catalogue accessed from user terminals[16]. It is also interesting to note that the librarian has reported a 46% increase in loans since the system became fully operational, following a programme of retrospective conversion. The Bookshelf suite of programs which has already been mentioned also includes a circulation control module which can be integrated with the catalogue.

Microcomputer-based circulation control is an option which many LIS can consider, but microcomputer systems can also be used by much larger LIS which already have an automated circulation control system based on a mini- or mainframe computer (as is the case with many university libraries, for example). In this case, microcomputers can be used as front ends to the larger system, either for real-time recording and uploading of transaction records, or in batch mode, when (say) one day's transactions are uploaded and merged with the main file. Microcomputers can also be used as a backup to the larger system, recording loans until the main system is back online, when records can be uploaded and merged.

Since most of the commercial packages available for circulation control provide various statistics of the use of stock (at least as far as borrowing is concerned), they can also play a part in general stock control and stock editing tasks, by indicating underused and highly used material, and thus suggesting titles which could be withdrawn and titles which could usefully be duplicated. Pikes Peak Library has indicated the next logical step in stock control, by using a portable microcomputer equipped with bar code reading equipment. The codes for each book on the shelf on the day of stock taking were read into the microcomputer and then merged with the records from the circulation control files to provide a file of books with a known location. Matching this against the online catalogue indicated, of course, any missing items. The library was able to carry out the entire stocktaking exercise in a fraction of the usual cost in staff time, making light of a task normally dreaded by most LIS managers![17].

There seems to be little doubt that microcomputer-based systems can now tackle many of the larger and more sophisticated tasks within the LIS such as circulation control. When this is allied with the provision of an online catalogue (using powerful software for retrieval), it provides an opportunity for many more LIS to automate at relatively low cost and, as Harper Adams College's experience suggests, with a consequent enhancement of the LIS's image.

REFERENCES

1. Stone, P., et al. Soft reading lists in Sussex. **Library Micromation News** (5) 1984.

2. Millar, P. and Cochrane, J. Administration of a reserve collection at Paisley College using dBase II. **Program** 19 (3) 1985. pp262-270.

3. Hare, C.E. and Winship, I.R. Using standard software for small-scale library projects: experience at Newcastle upon Tyne Polytechnic with Wordstar and dBase II. **Program** 20 (1) 1986. pp62-70.

4. Tomaselli, M.F. Microcomputer-based indexing and abstracting. **The Indexer** 14 (1) 1984. pp30-34.

5. Cline, G.N. Information retrieval for the 80's: CAIRS and Micro-CAIRS, in, **The application of mini- and micro-computers in information, documentation and libraries:** proceedings of the International Conference...Tel-Aviv, Israel, 13-18 March, 1983. Edited by Carl Keren and Linda Perlmutter. North Holland, 1983 (0-444-86767-8).

6. Shaw, D.S. Visicalc and the library acquisitions budget, in, **Online 83 Conference Proceedings,** 10-12 October, 1983. pp266-270.

7. Peasegood, A. and Stone, P. The model library: planning reshelving on a spreadsheet. **Library Micromation News** (5) 1984. p2.

8. Clark, P.M. **Microcomputer spreadsheet models for libraries.** American Library Association, 1985 (0-8389-0403-3).

9. Bailey, A.S. Creating and maintaining a database/databank comparison system with Lotus 1-2-3 on a (most of the time) IBM compatible micro. **Online 9** (2) 1985. pp86-92.

10. Borovansky, V.T. and Machovec, G.S. Microcomputer-based faculty profile. **Information Technology and libraries** 4 (4) 1985. pp300-305.

11. Diskin, J.A. and Fitzgerald, P. Library signage: Applications for the Apple Macintosh and MacPaint. **Library Hi-tech** 2 (4) 1984. pp71-77.

12. Everhart, N. and Hartz, C. Creating graphics with "The Print Shop". **Library Journal** 110 (8) 1985. pp118-120.

13. Bookshelf: an integrated, modular package for the smaller Library. **Vine** (54) 1984. pp37-38.

14. Dyer, H. CALM: computer aided library management. **Electronic Library** 3 (4) 1985. pp242-248.

15. Wood, L.R. A circulation control system on ACT Apricot. **Vine** (57) 1984. pp4-12.

16. Taylor, D. An online catalogue and issue system for smaller college libraries. **Library Micromation News** (5) 1984. pp14-15.

17. Dowlin, K.E. and Hawley, B.G. The use of portable microcomputers for library inventory. **Microcomputers for Information Management** 2 (1) 1984. pp67-73.

MICROCOMPUTER-BASED CATALOG CREATION SOFTWARE OPTIONS FOR SMALL LIBRARIES

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SUMMARY

This paper examines the microcomputer-based catalog creation options available to small libraries, suggests possible criteria for software evaluation, and describes, in terms of the suggested software evaluation criteria, 2 catalog creation software packages -- INMAGIC, a database management system and CARD DATALOG, an off-the-shelf catalog creation program.

1. INTRODUCTION

Microcomputer-based catalog creation software -- software intended to enable libraries to build an in-house database of machine-readable bibliographic records -- can provide small libraries with an affordable means of transcending the information retrieval limitations of the traditional catalog and of automating some of the routine functions associated with the generation of cataloging products. However, microcomputer-based catalog creation can also prove to be an expensive trap for the unwary.

This paper takes a pragmatic look at the microcomputer-based catalog creation options available to small libraries, and discusses possible software evaluation criteria. Two representative catalog creation packages are described in relation to the suggested evaluation criteria.

2. SOFTWARE OPTIONS

Essentially, managers of small libraries are presented with 2 microcomputer-based catalog creation options -- adapt a general applications database management system for catalog creation purposes or purchase an off-the-shelf-catalog creation program.

Database Management System Software

Powerful and flexible, microcomputer-based database management system (DBMS) software offers small libraries bibliographic independence and the opportunity to customize their bibliographic records to meet the information retrieval requirements of their users. The literature detailing how to build a machine-readable bibliographic database using DBMS software is instructive and sobering. Jim Gillespie's "A book catalog with two subject headings using dBASE", presents a detailed account of how to overcome dBASE II's inability to accept multiple values in fields (2:30-32). In "Database management systems in libraries : beyond dBASE II/III", Brian Phillips discusses the suitability of DBMS software for library applications and concludes that few librarians are qualified to evaluate or exploit the potential utility of DBMS packages for catalog creation purposes (4:62-66).

In general, the literature underscores the point that successful adaption of DBMS software for catalog creation purposes requires access to programming expertise and considerable time. Paula Lederman's warning that "most naive users using these [DBMS] systems use about 20% of their functionality because the real power of the systems are derived from programming in the database language" should be heeded by library managers (13:169). If the required programming expertise is not available in-house, libraries may wish to hire a consultant to customize DBMS software. However, beware of this option, without continued access to computing resources a customized DBMS package can easily be orphaned.

Off-the-Shelf Catalog Creation Software

Off-the-shelf catalog software is a product of the application orientation of software development during the mid-1980s. Software vendors, recognizing the commercial potential of catalog creation application software, either programmed existing DBMS software to perform catalog creation functions or developed microcomputer versions of minicomputer-based catalog creation software.

Catalog creation application software is attractive to libraries with restricted access to programming resources. The software is generally menu-driven and requires little (if any) computer expertise to operate. The cost of developing an application program, estimated as representing 80% of the total software cost (7:23), is dispersed among the purchasers of the software. The principal drawback of off-the-shelf catalog creation software is the inflexibility of the software. In general, libraries cannot adjust the software to meet the information retrieval requirements of their users.

Needs Analysis

Before embarking on a microcomputer-based catalog creation project, management should ask a fundamental question -- is microcomputer-based catalog creation appropriate for their library? To provide management with the information required to answer this question a needs analysis should be prepared. The management goals, system objectives, desired levels of system performance, and the political/situational constraints described in the needs analysis will define the automation requirement and form the framework of the software evaluation plan. The editor of Small Computers in Libraries, in a January 1984 article, provides a thought-provoking list of practical issues that should be addressed in any microcomputer-based catalog creation-related needs analysis (5:4-5).

Do not underestimate the importance of developing a needs analysis and of remaining committed to the priorities established in the needs analysis during the software selection/evaluation process. The tribulations of managers who did not prepare needs analyses and suffered accordingly are well documented in the case study literature. Bloch's paper "How not to specify an information retrieval system" is particularly instructive (1:551-555).

3. SOFTWARE EVALUATION CRITERIA

Software evaluation criteria, and the value assigned to each criterion, will be primarily determined by the priorities and requirements established in the needs analysis. However, there is general agreement among experts that, in addition to cost, the following criteria -- database size, record structure, ease of system operation, system products, documentation and customer service, and hardware -- should be included in any evaluation checklist for catalog creation software.

Database Size

Database size can be either hardware or software limited. This discussion is restricted to software limits on database size. To ensure the software is capable of handling the identified application, match the current size and annual growth rate of the collection with the record handling capacity of the software. If records are to be extensively indexed, determine the impact of indexing on the record handling capacity of the hardware. Intensive indexing of records can effectively double the storage requirement for each record. Evaluate the rate of decline in system response time relative to the increase in size of the database. Determine whether the software is portable to a minicomputer or mainframe.

Record Structure

Software record and field structures are either fixed or variable in length. Bibliographic records are variable in length. When establishing record structure evaluation criteria library management must decide whether or not to accept software which does not support the variable field and record lengths of a bibliographic record. Software which does not support variable length fields poses 2 problems. If the length of a fixed field exceeds the number of characters required to enter all relevant cataloging information, valuable memory storage will be wasted. On the other hand, the length of a fixed field may not be sufficient to store all relevant cataloging information.

The limits to information retrieval associated with abbreviated cataloging records may be over-rated. Paul Baxter, in a seminal work entitled "Microcomputers and the bibliographic record" examines the likely impact of microcomputers on the nature and use of bibliographic records. He concludes that the nature of the bibliographic record created by small libraries is "usually considerably simpler than full MARC records" and therefore small libraries will have little difficulty in using microcomputers for catalog creation purposes (1:514). Baxter also discusses the impact of shorter bibliographic records on information retrieval, and states that abbreviating bibliographic records does not appear to have a significant impact on information retrieval success rates (1:515-516).

User-definition of record and field structure offers users maximum flexibility in tailoring the structure of bibliographic records to meet the information retrieval needs of the library clients. Most off-the-shelf catalog creation software has pre-defined record and field structures. DBMS packages support user-definition of both field and record structures.

To provide adequate access to machine readable bibliographic records, catalog creation software should accept multiple values in specified fields.

System Operation

User-friendliness and ease of data entry are useful measures of ease of system operation. Menu-driven catalog creation software is user-friendly and easy to operate. Command-driven or modified menu-driven software that must be adapted for catalog creation purposes offers users more flexibility but requires that users possess some programming expertise. In order to disguise the lack of user-friendliess of such systems, a menu can be layered over the system. However, to layer a user-friendly menu onto a command-driven or modified menu-driven system requires time and programming skills. It took a professional programmer 500 hours to adapt dBASE II into a menu-driven catalog creation program called CARD DATALOG (4:63).

Online data entry worksheets are an integral feature of catalog creation application software packages. The worksheets are generally user-friendly, MARC compatible and support full screen editing. Online data entry worksheets must be created by users of DBMS software. DBMS software may not support full screen editing. To overcome the editing difficulties imposed by systems without a full screen editing feature, libraries can create online worksheets using a word processing package. Records created using the word processing package can be entered in ASCII format into the DBMS-created database.

Original input of bibliographic records is labour-intensive and time-consuming. The editor of Small Computers in Libraries estimated that 4 million characters would have to be input in order to create bibliographic records for a collection of 10,000 items (5:4). Downloading records from other machine-readable sources provides small libraries with an alternative to original input. Unfortunately, only a small number of catalog creation programs accept downloaded records. The importance of selecting software capable of accepting downloaded records is critical if the library intends to convert existing manual records into machine-readable form.

System Products

Typical system products required by libraries include: catalog cards, book catalogs, online catalogs, acquisiton lists, pocket and spine labels, and bibliographies. Off-the-shelf catalog creation software enables libraries to generate these products with a minimum of effort. Users simply select the required product option from the menu. The simplicity of the product generation process is balanced by the inflexible format of the cataloging products. Product formats are generally pre-determined by the software designer.

General applications DBMS packages can be programmed to generate traditional cataloging products as well as any other products or reports required by the library. However, the flexibility in product design supported by DBMS packages has a hidden cost. Effective product design requires a good working knowledge of the software package, and basic programming skills.

There are a number of catalog creation products on the market which do not create permanent machine-readable bibliographic records. The programs enable libraries to use a microcomputer as a word processor to produce book catalogs, catalog cards, spine and pocket labels, etc. The software is inexpensive (rarely more than US$250) and user-friendly. A typical cataloging product generation program is CATALOG CARD AND LABEL WRITER (US$177). The software is menu-driven, inflexible and extremely easy to use. All cataloging data must be keyed into the system using an online worksheet. Field lengths are fixed. For example, there is a 56 character limit on title entries. The total number of subject and added entries permitted is 8. Card and label formats are pre-determined and conform to Anglo-American cataloging rules (2nd edition) standards. The program does not accept downloaded bibliographic records or support the creation of permanent machine-readable records. The long-term value of programs such as CARD DATALOG is limited. Automation within an organization is often an evolutionary process. A building block approach to automation is therefore prudent. Cataloging product production programs not capable of creating permanent machine-readable records do not provide the automated foundation necessary for future library automation projects.

Documentation/Customer Service

Onsite training is rarely provided by microcomputer software vendors. System documentation is usually intended to serve as both a training guide and user manual. Therefore effective system documentation is essential. To be effective, system documentation must be clear, comprehensive and easy to follow. The manual should provide examples of major system features and basic troubleshooting advice. A good index is essential.

Telephone assistance is the standard type of customer service provided by software vendors. The service is rarely free. Vendors either charge by the hour or include telephone assistance as part of the software maintenance contract.

Hardware

Hardware selection should not determine software selection. If possible, hardware should be acquired to support the selected software. In general, catalog creation programs require powerful microcomputers with expandable memory storage. How powerful? To support a 25,000 record database using the CARD DATALOG catalog module requires an IBM PC AT with a 60 megabyte hard disk. If catalog cards are a required system product, select a printer with a 'bottom-feed' feature and adjustable tractor feed. Ensuring the hardware will accept future system enhancements and acquiring a maintenance contract are prudent measures. If considering acquiring a clone or compatible, test the selected software thoroughly on the hardware prior to purchase. Although vendors do not discourage users from acquiring clones, every software vendor I spoke with mentioned problems associated with running their software on clones or compatibles.

4. REPRESENTATIVE CATALOG CREATION SOFTWARE PACKAGES

INMAGIC and CARD DATALOG represent the state-of-art in general applications DBMS software suitable for catalog creation purposes and off-the-shelf catalog creation software. The intent of the following description of the 2 packages is to highlight the potential advantages and disadvantages of each of the catalog creation software options.

INMAGIC

INMAGIC (US$975) is a portable, powerful and flexible database management system. The software is command-driven and not particularly user-friendly. Although a computer novice can use INMAGIC, effective exploitation of the power of INMAGIC requires an intimate knowledge of the software.

INMAGIC is widely used for catalog creation purposes by North American libraries. It was recently adopted by the Canadian Dept. of the Environment as the approved catalog creation package for small departmental libraries. To facilitate the use of INMAGIC by libraries, the vendor developed BIBLIO, a guide to using INMAGIC in libraries. BIBLIO (US$145) provides database creation models and sample record structures for a number of library applications -- cataloging, acquistions, serials control, etc. This discussion is limited to INMAGIC's potential as a catalog creation tool.

Database Size

Database size is limited only by the disk storage capacity of the hardware. However, system response time does slow as the size of the database increases. The software is portable to a minicomputer. Thus managers need not be unduly concerned if the database size increases beyond the capacity of a microcomputer.

Record Structure

Because both record and field structures are user-defined, bibliographic records can be tailored to meet the information retrieval requirements of the users. Both record and field lengths are variable. Fields may be indexed by term -- the first 60 characters in any sub-field --and/or keyword -- each word in any sub-field. Up to 50 fields are indexable. Indexed fields take up considerable storage space. Therefore users should limit indexing to frequently searched fields. Fields not indexed can be searched. However, the system response time is much slower. INMAGIC supports Boolean searching.

System Operation

INMAGIC is a modified menu-driven system. Therefore effective use of the system is dependent upon users developing a good working knowledge of INMAGIC. In earlier versions of INMAGIC, because full screen editing was not a system feature, data entry was difficult. Corrections could only be made after all data had been entered for a record. To overcome this problem, users created online worksheets using word processing packages and entered records in ASCII format into INMAGIC in batch mode. INMAGIC, version 7.00, introduced in the summer of 1986 incorporates full screen editing. Records can be entered into an INMAGIC database interactively or in batch mode.

To download records from other machine-readable sources to INMAGIC is possible but difficult. Prior to converting downloaded records into INMAGIC the MARC field tags of downloaded records must be made INMAGIC compatible. The field tag amendments can be made using a word processing package. Password protection was introduced with INMAGIC version 7.00. Access to fields, records, and databases can be limited to authorized users.

System Products

The flexibility of the report generator module of INMAGIC permits libraries to define the format of system products. Possible system products include: catalog cards, book catalogs, online catalogs, spine and pocket labels, acquisition lists, bibliographies, etc. BIBLIO provides the computer novice with suggested product formats and record structures. However, to fully exploit the flexibility of the report generator feature and to develop custom-tailored products users must be prepared to devote considerable time to defining product formats.

Documentation/Customer Service

INMAGIC's system documentation is clear, concise and easy to follow. Examples of major system features and a basic troubleshooting guide are included in the manual. Users seeking guidance on how to adapt INMAGIC for library appliations can purchase an additional software guide called BIBLIO. Although the documentation is designed to serve as a self-contained training package, onsite training is available from the vendor. The charge for a half-day training session is US$500 plus expenses. Telephone training assistance is available free of charge for the first 45 days of system use. Continued telephone customer service is available for US$150 per quarter. To promote information sharing among INMAGIC users, the vendor publishes a monthly newsletter.

Hardware

INMAGIC operates on hardware supported by the MS DOS, DEC PC and 350 operating systems. The vendor estimates that an IBM PC AT equipped with a 20 megabyte hard disk is required to support a collection of 10,000 items.

CARD DATALOG

CARD DATALOG is an integrated library system marketed by DTI DataTrek. The software is user-friendly, tailored to library applications, and menu-driven. The system consists of a number of modules -- cataloging, acquisitions, circulation, serials control, av handler, etc. The modules can be acquired together or separately. The catalog module enables users to build a MARC-compatible machine-readable database and to use that database to generate cataloging products. This discussion of CARD DATALOG is limited to the cataloging module.

Database Size

Database size is software limited. The basic version of the catalog module (US$2450) will accept up to 65,000 records. The enhanced version of the catalog module (US$4995) will accept up to 150,000 records. The software is not portable to a larger system.

Record Structure

Both record and field lengths are fixed. Record lengths are limited to 25 fields. An estimate of the average number of characters in each field in the average MARC record was used to establish field lengths. Multiple values are accepted in the following fields : author, subject, added entry, cross reference, volume and copy number. Records are searchable by author, title, subject, series, added entry, call number, cross reference and accession number. Boolean searching is supported.

System Operation

Because CARD DATALOG is menu-driven and inflexible, the system is easy to learn and operate. Users select the desired option from the menu, and subsequently respond to system prompts. The online worksheet is MARC compatible and supports full screen editing.

To enable users to exploit the existing resource base of machine-readable bibliographic records, the vendor has created a downloading program called DATABRIDGE. DATABRIDGE (US$975) enables libraries to download full MARC records to the CARD DATALOG database. The vendor is currently experimenting with using DATABRIDGE to download MARC compatible records to CARD DATALOG. The software supports online authority files and cross-references.

System Products

Cataloging product options offered by CARD DATALOG include : spine and pocket labels, book catalogs, catalog cards, online catalogs, shelf list cards, acquisition lists and authority lists. A variety of product formats are supported by CARD DATALOG. For example, the menu offers 4 acquisition list formats, 3 printed catalog formats, etc. To generate the desired product users select the appropriate product option from the catalog menu.

Documentation/Customer Service

CARD DATALOG's system documentation is designed to serve as both a training package and user manual. The documentation is well organized, easy to follow and suitable for a computer novice.

Onsite training is not available from the vendor. Telephone training assistance is available at a cost of US$30/hour plus communication charges. The CARD DATALOG maintenance contract (US$500/year) entitles the client to annual software updates and telephone customer assistance.

Hardware

CARD DATALOG operates on hardware suppported by MS DOS, CP/M or MP/M operating systems. As stated previously, an IBM PC AT equipped with a 60 megabyte hard disk is required to support a collection of 25,000 items.

Sources of Software Information

Information concerning other software suitable for catalog creation purposes can be located by consulting any of the current library software directories. Jeanne Nolan's Micro Software Evaluation is particularly useful. The directory describes software suitable for library applications. Each description includes a review of the software provided by a library using the software. The Directory of library and information retrieval software for microcomputers, compiled by Hilary Gates is another useful directory.

Software reviews provide a useful contrast to the over-blown ratings of software capabilities supplied by many software vendors. In addition to the previously mentioned, Micro Software Evaluations, the following periodicals often contain informative software reviews : Library Software Review, Small Computers in Libraries, Microcomputers for Small Libraries and Information Technology and Libraries. The most effective software review mechanism is to acquire a demonstration disk from the software vendor and test the software in-house.

5. CONCLUSION

Cost-effective selection of microcomputer-based catalog creation software requires management to make a realistic assessment of in-house bibliographic control requirements, in-house computing expertise and available funding. As a general rule, the initial cost of acquiring off-the-shelf catalog creation software is at least twice the cost of acquiring a DMBS package. For example, the off-the-shelf catalog creation program CARD DATALOG costs US$2450; INMAGIC, a DBMS package suitable for catalog creation purposes costs US$950. However, the hidden costs -- staff time, consultants fees, cost of utility programs, etc. -- associated with adapting a DBMS package for catalog creation purposes rapidly inflate the cost of this option. Libraries with limited access to programming expertise and software development funding may conclude that off-the-shelf catalog creation software is the most cost-effective approach to microcomputer-based catalog creation.

REFERENCES

1. The application of mini-and micro-computers in information, documentation, and libraries. C. Keren and L. Perlmutter, eds. Amsterdam : North-Holland, 1983.

2. "Book catalogs with two subject headings using dBASE." Jim Gillespie. Small Computers in Libraries. 6(2) : 30-32, February 1986.

3. "Cataloging for the local online system." Judith Hudson. Information Technology and Libraries. 5(1) : 5-27, March 1986.

4. "Database management systems in libraries : beyond dBASE II/III." Brian Phillips. Library Software Review. 5(2) : 62-66, March-April 1986.

5. "Developing micro-based online catalogs." Small Computers in Libraries. 4(1) : 4-5, January 1984.

6. A directory of library and information retrieval software for microcomputers. Hilary Gates. Aldershot : Gower, 1985.

7. "Identification and evaluation of software for microcomputer-based in-house databases." Carol Tenopir. Information Technology and Libraries. 3(1) : 21-34, March 1984.

8. "Label management, the LIBRARIAN'S HELPER." Judith M. Prosser. Library Software Review. 5(2) : 103-105, March-April 1986.

9. "Library software for microcomputers." Paul F. Burton and Hilary Gates. Program : Automated Library and Information Systems. 19(1) : 1-17, January 1985.

10. "Mainframe magic on a micro." Jane S. Johnson. Library Software Review. 5(1) : 4-8, January-February 1986.

11. Micro software evaluations. Jeanne M. Nolan, ed. [s.l] : Nolan Information Management Services, 1984.

12. "Microcomputer-based library catalog software." Gerald Lundeen and Carol Tenopir. Microcomputers for Information Management. 1(3) : 215-228, September 1984.

13. Online '84 Conference Proceedings. Weston, Conn. : Online Inc. 1984.

14. "Printing catalog cards." Small Computers in Libraries. 4(5) : 2, May 1984.

15. "Using TRS-80 Scripsit for book labels.: Small Computers in Libraries. 3(1) : 2, January 1983.

BIBLIOGRAPHIC NETWORKS AND MICROCOMPUTER APPLICATIONS FOR AEROSPACE AND DEFENSE SCIENTIFIC AND TECHNICAL INFORMATION

by

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ABSTRACT

Bibliographic networks provide the means for sharing information resources among geographically dispersed libraries. As part of a bibliographic network, a single library can access a wide variety of bibliographic information, participate in shared cataloging, and acquire holdings (purchase or loan). This paper describes (1) the functions and operations of libraries supporting aerospace and defense scientific and technical work, (2) the environment and characteristics of bibliographic networks, and (3) the automated system capabilities required for network participation. A discussion of the use of microcomputers as cost-effective, yet powerful tools for exploiting bibliographic network resources is included. An automated system being developed for U.S. Department of Defense technical libraries is described. This system integrates local library functions with capabilities for accessing bibliographic network resources, both government and commercial.

INTRODUCTION

Throughout the public and private sectors, organizations sponsor or conduct scientific research to support development of new products or services. Research and development spending in the U.S., including both the private and federal government sectors, will total $122 billion for 1986. Top U.S. corporations spent $48.8 billion in 1985 on research and development, a full 3.1 percent of sales /1/. Since 1978, the U.S. Department of Defense has allocated over 10 percent of its budget to research and development /2/. Regardless of sector, research and development represents an investment in the future -- future economic success for private companies and future quality of life for a society. Private sector companies fund research on the basis of risks and rewards of profitability. Governments conduct or sponsor research in areas where the private sector cannot economically justify participation: areas of high risk of failure, or where development of a commercially valuable product cannot be assured.

Original or applied research, by its very nature, is both a consumer and a producer of technical and scientific information. Researchers scour available technical and scientific information to prevent duplicating the work of others or to gain an advantage by building on the results of others. Depending on the proprietary nature of the findings, researchers may publish research results for the benefit of others working in the field or to establish rights or claims to the commercially valuable by-products of the research. Most research centers and laboratories, whether private or government, provide information services to staff members through technical libraries or information centers.

(Throughout this paper, reference is made to both technical libraries and information centers. In some instances, the designations are not interchangeable. In addition to offering the traditional library services, information centers provide more "information processing" services -- compilation, analysis, synthesis -- than technical libraries. In the U.S. Department of Defense, the term "information analysis center" is used to designate these organizations. However, the same automation requirements apply to both types of organizations when considering their common, fundamental objective: providing bibliographic information services to a community of patrons working in aerospace and defense industries or government agencies. The designation of "technical library" is intended to encompass the bibliographic information services provided by information centers.)

This paper focuses on the characteristics, operations, and automation requirements of technical libraries providing information services to organizations -- private and government -- involved in aerospace and defense scientific and technical work. These technical libraries have the following general characteristics in common:

- They are affiliated with and provide services to an organization performing original or applied research and experimentation, testing, or evaluation.
- The work is technical in nature, but can encompass social, as well as physical sciences, mathematics, or engineering.

- Patrons need general scientific and technical reference services, but will tend to have very specific subject interests reflecting the objectives or assigned missions of the laboratory or research center.
- As a result of patron interests, the library will maintain a local collection of bibliographic materials (books, technical reports, journals, serials) tailored to patron needs.
- To complement the local collection, the library must also rely on a broad range of external resources (on-line bibliographic catalogs, document distribution services, book sellers, and other libraries).

BIBLIOGRAPHIC RESOURCES

Technical libraries call upon a mix of internal and external bibliographic resources to meet patron needs. Internal resources are the catalogs, automated systems, and holdings belonging to and contained within the technical library and its facilities. External bibliographic resources -- those not belonging to or contained within the library -- include both commercial and government data bases, document distribution services, interlibrary loan agreements, book sellers, and commercial subscription services. Even information specialists and reference librarians of other libraries, if conveniently available, can be considered external resources. Commercial and government data bases contain citations to (or even full text of) books, serials, journals, and technical reports.

Technical reports are unique to the scientific and technical information community: they document procedures and results of contemporary research and focus on a comparatively limited scope of technology or science. Unlike books or monographs, technical reports allow rapid, timely dissemination of research findings. Unlike serials or most journals, technical reports can be used to limit distribution of research findings to a select community of readers. This distribution limitation can be based on protecting national interests (security classification restrictions) or to protect the proprietary information of private organizations from competitors.

Over 20 years ago, the U.S. Library of Congress offered a standard format for exchanging book, monograph, and journal citations on magnetic tape. Referred to as MARC -- machine-readable cataloging -- the format is the de facto catalog citation standard for countless libraries throughout the world. Consequently, many automated systems used to catalog and retrieve book and monograph citations have been designed and implemented around the MARC magnetic tape citation exchange format. In contrast, there is no similar standard for cataloging and subsequently exchanging technical report citations.

Over 2,000 commercial and government data bases are available throughout the world /3/. These range from readily available commercial sources (e.g., DIALOG, SDC/ORBIT, Karlsruhe, PASCAL, DARC) to government data bases where access may be restricted, because of national security or proprietary interests, to a closed community of users. For commercial data bases, access is restricted only by a user's ability to establish a dial-up telecommunications connection to the service and the ability to pay the going rate for the service. In comparison, access to many government data bases is based on the user's participation in or contribution to sponsored research. Access may mean permission to connect to (via telecommunications lines) and search a data base directly, or it can also mean access to data base contents through an intermediary -- an information specialist or reference librarian. Within the defense and aerospace scientific and technical information community, bibliographic data bases or related services are provided by the U.K. Defense Research Information Centre, the European Space Agency, the U.S. Defense Technical Information Center, and the U.S. National Aeronautics and Space Administration. These organizations serve government and government contractors participating in aerospace and defense scientific and technical research and studies.

While there is a wealth of publicly and privately available scientific and technical information, there is little commonality among data bases with regard to citation format, indexing structure and terminology, or retrieval language. As a result, users must learn the structure, content, and retrieval language of each data base accessed. Even more fundamentally, the mechanics of simply connecting to different data bases -- selecting the correct communications protocol and terminal characteristics (number of data bits, parity, number of stop bits, etc.), dialing the correct telephone number, and executing the correct log-in steps -- can differ widely. Mastering all the aspects of searching several different bibliographic data bases is a formidable challenge for the information specialist or reference librarian. It can be an insurmountable barrier to occasional users, such as scientists, engineers, and researchers.

Access to on-line bibliographic data bases provides the tools for identifying information of interest to patrons. However, the objective of the technical library is to deliver the actual work -- technical report, book, journal article -- to the patron. With the exception of a few full-text data bases, patrons receive scientific and technical information in printed media: paper copy or microform. For items not contained in the local collection, this means locating a source (which may be different from the source of the citation information), placing an order for purchase or loan, tracking delivery to the patron, and perhaps returning a loaned item or cataloging a new item for addition to the local collection. This process is time-consuming for the library staff, limiting the number of requests that can be handled. It is also frustrating for the patron, who may perceive the process as slow and unresponsive to his or her needs.

As a complement to reference services provided to patrons, technical libraries perform original cataloging of new holdings, many of which are published by the research center or laboratory served by the library. In many cases, the

publications of the research center or laboratory are requested by other centers or laboratories. The library may have responsibility for this secondary distribution. The publications may be eligible for cataloging in a central data base shared by other technical libraries or information centers in the research community. As is the case with the U.S. Defense Technical Information Center, not only is the citation cataloged into a central data base (the Technical Reports data base), but the document is available for distribution on request from authorized users..

Regardless of the source of new holdings -- locally published technical reports, purchased materials, loaned items -- the library must create and maintain a record of descriptive, and in most cases, subjective bibliographic information. This is the essence of a local bibliographic catalog. Descriptive information is taken from the title page of the holding; subject information is derived from the contents by a cataloging specialist. For loaned items, a minimum of information is kept to allow circulation control. For items added to the local collection, more extensive bibliographic information is retained, facilitating retrieval of the document in accordance with subject content and descriptive information.

In contrast to the manually intensive interlibrary loan process, cataloging is predominately an intellectual effort augmented by manual effort for typing catalog cards or for keyboarding the bibliographic information into an automated system (the latter being preferable and consistent with the thrust of this paper). As with interlibrary loans, staff size and productivity influence the amount of original cataloging a library can do as part of adding items to the local collection. In the case of locally published technical reports, the catalogers in the library serving the research center or laboratory are subject matter experts when it comes to developing subject indexes, terms, and key word lists for those reports.

In most cases, the cataloging and indexing subject matter expertise is lost when the holding is acquired by other libraries. The report will be cataloged again as a new holding in another library, consuming scarce intellectual and manual effort in the process. This occurs every time another library acquires the report. Over and over again, effort is duplicated and essentially wasted because the citation, unlike the actual report, was not "acquired." While libraries may catalog reports using slightly different formats, there is strong commonality in the information kept. Even if the entire citation could not be used, the portion used would still reduce duplication of manual and intellectual effort and make the library staff more productive.

TECHNICAL LIBRARY FUNCTIONS AND PROCESSES

Translating functions and processes into computer system requirements is the first step toward developing or selecting a system tailored to the special needs of technical libraries. For technical libraries, participation in bibliographic networks must be integrated with local collection management functions. This carries over to the design and development of automated systems for technical libraries. It is counterproductive to burden the library staff with different computer systems, procedures, and languages for each external resource used by the library. Rather, it is advantageous to design and implement a single, integrated automated system with capabilities for local collection combined with capabilities for accessing resources through bibliographic networks. The objective is to integrate access to network resources -- book sellers and subscription services, bibliographic data bases, document distribution services -- with access to locally maintained resources -- a local collection of holdings, a local catalog, circulation records.

A brief description of technical library functions follows. It is presented to establish general automated system requirements for libraries participating in bibliographic networks. Accordingly, access to both local and external bibliographic resources is considered. The following library functions are considered in developing system requirements: acquisition, cataloging, reference, and circulation management and control.

Acquisition

Acquisition involves locating sources (book sellers, vendors, government agencies, other libraries) for obtaining new holdings, ordering and tracking the status of new holdings, accounting for expenditures against an acquisition budget, and tracking and returning items obtained on loan. Ordering and claiming serials on subscription are also included as part of the acquisition function. All holding types -- books, monographs, serials, journals, technical reports -- are covered under a single acquisition function. Separate processes may be used for each holding type, but the processes support a common function.

Cataloging

All types of holdings are subject to cataloging: books, monographs, serials, journals, microfiche, and technical reports. Cataloging consists of creating a skeletal record when new items are ordered, developing the descriptive cataloging record from holding information, selecting subject terms for indexing, and editing citations as information on the record changes. Cataloging includes (1) adding new citations to a catalog of holdings maintained locally by the library and (2) sharing citations cataloged in the local system with other libraries.

Citations can be shared via two media: printed or electronic. The benefit of sharing citations electronically is reduced manual effort from a reduction in keyboard entry of information. Citations may be shared electronically by:

- cataloging directly into a shared, central data base
- transferring citations from the local catalog to a central data base (uploading)
- allowing access to the local data base by other libraries for the purpose of "withdrawing" or "downloading" citations.

Of the three methods of sharing citations electronically, the last two are preferred over the first when a local catalog is maintained. Assuming that a central, "closed community" catalog is maintained, as is the case, for example, at the U.S. Defense Technical Information Center, transferring citations from the local catalog is preferable. If the catalogs use different formats for citations and citation contents, translation to a standard interchange format is required. Where the translation takes place is a function of policy, negotiated between cataloger (technical libraries) and data base owner.

Technical reports published by the laboratory or research center supported by the technical library will be first cataloged by the library. As other libraries request the holding, they can be given access to the citation as well. Conversely, when a new holding, other than a locally published report, is obtained, its citation, if it exists in an electronic medium, should be obtained. This practice should be applied to other holding types, within limits imposed by availability of machine-readable citations and copyright protections.

Reference

With a catalog of citations to holdings held in a local collection, library staff members search for and select resources that can be provided to the patron almost immediately. However, searching the local collection is not totally adequate. To avoid costly, wasteful duplication of research effort, a more comprehensive search of closed community and publicly available resources is essential. This means gaining access to one or more external data bases; performing a thorough, comprehensive search; and creating a composite bibliography -- by merging the search results from more than one source --sufficient to meet a patron's needs.

Functionally, reference consists of selecting target data bases to search, searching external and local data base(s), downloading citations from external sources, merging citations to create a patron bibliography, and reviewing the bibliography with the patron. Citations contained in the bibliography provide information to the acquisition function, when a patron requests a holding not in the local collection.

Circulation Management and Control

Circulation management and control includes registering patrons (establishing access privileges and security clearances, as necessary), charging holdings out to patrons, charging holdings out on loan to other libraries, discharging holdings returned by patrons and from loan, maintaining information on the status of all holdings, and tracking bindery operations for serials and journals. In technical libraries with classified or proprietary holdings in the local collection, document inventory and signature accountability of documents is a necessary and integral part of circulation management and control.

Other Functions

The preceding four functions account for the core of library operations and, consequently, form the core functions of an automated system supporting the library. However, other library management functions are amenable to automation and should be considered when designing or selecting a system. These other functions can be included as part of the basic system, but more likely, as augmentations to the basic system software because of their functional heterogeneity. Other functions suitable for automation within technical libraries include word processing, generalized data base management (creating, updating, and retrieving from text or numeric data bases), and management reporting.

Summary of Functions and Processes

- Acquisition
  - Locating sources
  - Ordering and tracking (booksellers, reprint services, document services)
  - Interlibrary loans (borrowed items)
  - Budget and accounting
- Cataloging
  - Downloading, translating, and reformatting citations
  - Creating original citations
  - Transferring citations to other on-line catalogs

- Reference
  - Locating and selecting data bases
  - Local collection searching
  - Searching external data bases
  - Downloading, merging, and duplicate reduction
  - Post-processing (sorting, concordances, permuted listings)
  - Storing, transmitting, and reviewing citations
- Circulation Management and Control
  - Charging and discharging holdings
  - Registering patrons
  - Interlibrary loans (loaned items)
  - Classified and proprietary information accountability
- Office Automation and Management Support
  - Word and text processing
  - General data base management (text and numeric)
  - Management reporting
  - Electronic mail.

LOCAL SYSTEM AND NETWORK INTEROPERABILITY

There are trade-offs in designing and configuring an automated system for both local library functions and bibliographic network functions. If existing, shared external resources (e.g., data bases, ordering or book seller services, document distribution services) are to be accessed, their capabilities, features, and limitations must be accommodated and, in some cases, compensated for in the local system. Seldom will a community of libraries have the opportunity to set requirements for both local systems and shared network resources without being constrained, at least in the short term, by existing capabilities. Furthermore, government and commercial data base providers and other vendors (book sellers) must meet the needs of a wide variety of users. In general, you use the service as provided, with many vendors willing to accommodate broadly supported (by users) changes as resources permit.

The lack of standardization -- in command and retrieval languages, data base structure, citation formats, indexing terminology -- among data bases and related bibliographic services places an enormous burden on the user. Standardization, as a short-term solution, is economically out of the question for most vendors and suppliers. Over time, standards will be established and implemented, given the economic incentives to do so. For example, the EURONET/DIANE project produced a common command language intended to be used across a number of bibliographic data bases available in European countries. The International Standards Organization has proposed a standard command set and syntax for bibliographic retrieval using on-line systems. A related effort has produced a draft of a bibliographic retrieval command language within the United States.

While attempts at establishing standards go on, the lack of standardization can be compensated for in local automated systems. Most notably, the local library computer system can be used to translate commands between systems and a common or standard command language, translate citations from external systems to a local format, and significantly reduce the burden of establishing connections to external systems and data bases.

Relying on centralized versus decentralized (distributed) processing is the fundamental trade-off in designing systems for participation in bibliographic networks. At one extreme, all computer processing (hardware and software) and information resources (data bases, distribution services) are centralized, with no duplication of capabilities or resources. At the other extreme, resources are scattered geographically and organizationally, and every network participant owns and maintains a substantial collection of resources, with much duplication. The reality of libraries participating in bibliographic networks lies somewhere in between the two extremes. Economics and technology dictate the specific mix of centralized (shared) resources and distributed (with some level of redundancy) resources. Considerations in arriving at the mix of resources include response to user requirements (timeliness and functionality), required processing power, telecommunications versus local system costs, and comparative costs of alternatives.

Acquisition

Several vendors offer on-line ordering of books and serial subscriptions. For example, in the U.S., Ballen offers dial-up access to information so that users can place and track book orders. EBSCO and FAXON offer on-line subscription services, claims requesting, and ordering of back issues for serials. In addition, funds accounting and budget tracking capabilities provide useful information for library management. These three services are self-contained in that the complete application runs on a central computer and is accessed by the user through dial-up communications lines. Access requires a terminal capable of dial-up, asynchronous communications.

In offering these services, companies attempt to provide a complete acquisition service to libraries. That is, each company may offer on-line ordering, order tracking, expense accounting, and budget management. However, most libraries must rely on more than one of these companies to meet patron requirements. For example, the library will have one service for periodical literature, another for scientific and technical books, and yet another for government publications. This fragmentation of the systems supporting the acquisition function requires the staff to use multiple, dissimilar procedures to perform one function. Using a single vendor is not a solution. Using a single procedure for multiple vendors is a more realistic approach. What "standard" set of procedures should each vendor adopt so as to provide a single procedure? In all likelihood, agreement on a standard procedure will not occur. It falls to the user -- the technical library -- to rationalize the multiple procedures into a standard set of procedures suitable for effective library operations.

Use of on-line acquisition services must be integrated with the local catalog as well. For example, the library staff must be able to determine whether an item requested by a patron is already on order. To do so may require dialing into several on-line ordering services to answer the question. Alternatively, order information from each service used can be kept in the local computer system. This information must be integrated with the local catalog, else little is gained by requiring the staff to search two disjoint local data bases.

Similarly, accounting and budget information available on several different on-line services must be consolidated to reflect total acquisition expenditures and balances. Where does this consolidation take place? On one of the vendors' systems? Perhaps, but more appropriately, the library will want to maintain consolidated acquisition accounting and budget information on the local computer. However, the information in the local system must reflect the latest information available from the vendor systems. Timeliness and accuracy of the information would be improved if there were a way of automatically updating the local system with data from the dial-up services.

To use on-line ordering systems effectively, the local library system must be the focal point for consolidating order, accounting, and budget information. The local system duplicates some of the on-line services capabilities: limited order tracking (with whom was the order placed, when, when is delivery expected?), expense accounting (by item, by vendor), and budget management (what has been expended vs. what was budgeted for, projections of future budget based on past requirements). However, the local system consolidates information from all sources, providing an integrated view of the acquisition function. The local system complements the on-line services in that skeletal citations, created from order information when the order was placed, can be searched as part of a local catalog of citations. This enhances the reference services provided to patrons and reduces duplication of orders for new items.

Technical libraries participate in interlibrary loan networks, largely for access to serials, specialized journals, and books. Nation-wide and regional interlibrary loan networks make it possible for participating libraries to access a rich and diverse collection of holdings without the cost of buying each item. Several networks offer dial-up access for locating and requesting holdings through interlibrary loan. A central computer system is used to maintain a union list of holdings of libraries in the network and to track loans among participating libraries. As with book ordering and subscription services, a library may belong to more than one interlibrary loan network.

Items obtained through interlibrary loan are subsequently charged to library patrons. To track the borrowed item, the library staff must create a temporary bibliographic citation for circulation management and control. If bibliographic information on the borrowed holding is available from either the lending library or the interlibrary loan network computer system, it can be transferred electronically to the local system. This eliminates the need to keyboard the information into the local system manually, while making the information readily available to the library staff.

Cataloging

Libraries may choose to catalog local holdings into a central data base accessible on a bibliographic network. This eliminates the need for a local computer (for cataloging), but places the library in the position of accepting the responsiveness and availability of someone else's computer and software. This approach has been used for years in the U.S. for monographs, books, and serials cataloged using the OCLC, Inc. on-line system. In taking this approach, the library must be satisfied with the functionality, responsiveness, and limitations of the central system, not only for cataloging but for reference as well.

While sharing a central catalog may be satisfactory in some circumstances, most libraries need and can justify the responsiveness of a locally maintained catalog. Among a community of libraries with common interests and objectives, a central catalog offers the means for expeditiously sharing bibliographic information. Local collections and catalogs maintained by individual libraries provide responsiveness to patron needs, while shared cataloging into the central catalog promotes rapid dissemination of technical and scientific information. Libraries participate in shared cataloging with the expectation of getting benefit in return. This would be the case if the central catalog contained citations to holdings not readily accessible elsewhere, as is the case with classified or proprietary technical reports. The central catalog is then an extension of, not a replacement for, a local catalog.

Shared cataloging -- cataloging into a local system and into a central system -- can result in a duplication of effort for participating libraries. If duplicate entries are required for both the local and central catalog, libraries will be

reluctant to participate, little improvement will be made in timely dissemination of information, and participation will eventually cease. If a single entry can be made in the local system and that same entry, with minor modifications, electronically sent to the central data base, then shared cataloging will cost participants little.

Reference

Library staff members must be able to search a local catalog by subject (key words, index terms, or free text), title, author, publisher or source, date of publication, and type of holding. This provides the patron with rapid access to scientific and technical information held in the local collection. To complement information contained in a local collection, library staff members must have access to external bibliographic data bases. In essence, these external data bases become an extension of the local catalog. However, searching both a local catalog and several external data bases can be time-consuming and costly. Managing the flood of information resulting from these searches can be overwhelming, resulting in poor service to patrons.

It is clearly advantageous to have access to external data bases. However, it is equally advantageous to have a local system with a catalog to local holdings. To integrate these two resources, the local library computer system must be able to connect users to the external sources, allow searching of the data bases, and support transferring citations from remote systems to the local system. Once on the local system, the citations can be merged together with local citations, sorted, searched again (without the connection costs associated with remote systems), and further processed for delivery to the patron. By having this capability in a single local system, the library staff create comprehensive, relevant bibliographies for patrons with little duplication of effort and with a significant reduction in manual effort.

Circulation Management and Control

Libraries participating in interlibrary loan networks often lend, as well as borrow items. Tracking items on loan to other libraries is essential for preserving the local collection. Through an interlibrary loan network, technical libraries can electronically share citations for loaned items with borrowing libraries. This speeds the loan process and can result in a more accurate circulation record for the borrowing library, reducing the chance of losing an item or delaying return to the lending library.

SOFTWARE AND HARDWARE CONSIDERATIONS

Participation in a bibliographic network requires little more than a terminal and modem. However, this austere configuration provides no local processing capability: no local catalog, no capability for local applications software, and, most important, no way for integrating local resources with those available externally. More processing power (more than a terminal and modem) is needed to effectively and productively meet the automation needs of libraries supporting aerospace technical and scientific research. With today's technology in microcomputers and applications software, it is possible to implement a system capable of supporting local collection management and accessing external, on-line bibliographic resources. The challenge is integrating the hardware and the applications software needed for full functionality.

Hardware

Microcomputers are appealing for use in library automation. They are comparatively inexpensive, yet offer adequate processing power for specialized applications. Micros operate without a great deal of operator intervention and within environments commonly found in any office or library. This section contains a brief discussion of hardware characteristics needed for library automation.

Microcomputers can be categorized by the number of users able to access the system concurrently. Many micros are single-user systems. These can be useful for network and library applications, but trying to support multiple functions concurrently -- reference, circulation, cataloging -- causes contention among staff members and hinders library operations. A multi-user system is preferable for these very reasons: several users can access the whole range of system functions, responding as needed to changes in library work flows and patron requirements. In addition to supporting multiple users concurrently, the computer should be multi-tasking. That is, each user can concurrently perform more than one process (execute more than one program at a time, for example). This is essential for effectively integrating local functions with capabilities for accessing bibliographic network resources.

Communications capabilities are at the core of any system supporting bibliographic network access. Most on-line bibliographic services -- book sellers, subscription services, data bases -- provide users with dial-up, asynchronous communications. For reasons of economy and responsiveness, these services offer access at 1200 baud or higher. Modems are available to support higher dial-up speeds reliably, and many services are offering the higher speeds. To facilitate dial-up access, modems are available with built-in automatic dialers for both pulse and tone dialing.

Disk storage costs have dropped dramatically since 1983, while device capacity has risen. Disk storage devices provide the responsiveness, economy, and reliability needed for maintaining a local on-line bibliographic catalog. For estimating disk storage requirements for catalogs, allow 2.5 kilobytes for each citation stored, plus an additional 60 percent for storage overhead. Allow 10 to 15 megabytes storage for the operating system and utilities and 5 to

10 megabytes for applications software. For example, with a 60-megabyte Winchester technology disk drive, a catalog of approximately 10,000 citations can be supported. Downloading citations and creating merged bibliographies requires additional disk storage. However, today's microcomputer systems can support multiple, high-density disk drives, providing as much as 1 gigabyte of storage on so-called "super" microcomputers.

The following hardware configuration is based on equipment readily available for library automation. The system as configured will support two users, but can easily be expanded to eight. Disk storage is estimated on a collection of 25,000 holdings, with allowances for downloading from external data bases. Concurrent access to two external, on-line services is supported (this can also be readily increased). This configuration represents the minimum for a system capable of both local collection management and access to external bibliographic network resources. It has an estimated purchase price of less than $20,000 (U.S.):

- A multi-user, multi-tasking microcomputer central processing unit with 2 megabytes of real memory, 8 serial (asynchronous) ports, printer interface, disk and tape unit controllers, and operating system
- Two 80-megabyte Winchester disks with tape cassette back-up
- Two terminals and cabling for local connections
- One printer
- Two auto-dialing modems (1200 baud).

Software

Rather than discussing specific applications software, this section presents a brief description of the characteristics needed for a local collection management system integrated with network access capabilities. References for use in identifying and selecting software suited for local collection management functions -- acquisition, cataloging, retrieval, circulation management and control -- are included in an appendix. These references provide lists of available products and contain reviews of software for library automation.

Library Functions. Software supporting local collection management functions (i.e., acquisition, cataloging, retrieval, and circulation management and control) must be well integrated. Files created for one application must be shared with another application requiring the same information. For example, data entered or added by a cataloger must be automatically shared with circulation management and control applications. Moving from one function to another is accomplished through a consistent set of commands, rather than through hierarchical menus or apparent execution of individual programs.

Detailed lists of software features and capabilities for general and technical library automation are contained in References /4/ and /5/, respectively. The following software features are highlighted to point out the key areas of interoperability between local collection management and access to external resources:

- Acquisition
  - Accept data downloaded from external data bases into acquisition tracking, accounting, and budget files maintained on the system
  - Automatically reformat data from external sources into format required for local files
  - Share descriptive bibliographic information (skeletal citations) developed to track acquisitions and borrowed items with retrieval programs used for searching the local catalog
  - Share skeletal citations with cataloging applications to reduce the duplication of data entered for new or borrowed holdings
- Cataloging
  - Allow the cataloger to easily edit and reformat citations downloaded from external data bases for addition to the local catalog
  - Automatically reformat downloaded citations to the local format for frequently used data bases
  - Extract citations from the local catalog for electronic transfer to other systems
  - Automatically translate citations from the local catalog format to the formats required by data bases to which citations are frequently sent

- Retrieval
  - Concurrently search the local catalog and selected external data bases using a common command language
  - Provide real-time feedback to the searcher on search results, and permit search refinement
  - Download citations from external data bases, translate them into a common format, and merge them in with citations from the local catalog
  - Search the merged set of citations, sort them by user-specified keys, and provide summary information useful to the patron.

Network Access. Applications software for accessing and exchanging information with external bibliographic resources must work in concert with software for local collection management. Network access software must perform the following functions to make the integration effective:

- At the request of the user, dial, connect, and log into a remote data base
- Control the flow of information between a user's terminal and the remote host
- Direct information from a user's terminal to intermediate programs and then into a remote data base (e.g., programs for command translation)
- Direct information from remote data bases to temporary files or intermediate programs on the local system (e.g., citation format translation programs)
- Allow the user to communicate with both the local system and the remote system, as required.

Despite a lack of standardization in communications protocols, command languages, and data formats, accessing external data bases can be simplified for the user. With "intelligent gateway" **/6/** features, a computer system can provide automatic connections and log-ins, perform concurrent searches of multiple, heterogeneous data bases, and capture information on a local system. Specific capabilities have been demonstrated for concurrent searching, downloading, and post-processing bibliographic information **/7/**. These features can be provided in a centralized computer, acting as an intermediary device between the user and the external data bases **/8/**. Alternatively, a local system can be equipped with gateway capabilities, offering the added benefit of concurrently searching a local catalog and several external data bases **/9/**.

A microcomputer-based library system can provide gateway access to the most frequently used bibliographic network resources, providing a link between local functions (acquisition, cataloging, retrieval, and circulation management and control) and network services (book sellers, subscription services, document distribution services, bibliographic data bases). For less frequently used network resources, the local system can access a centralized gateway computer. This central gateway in turn contains the translators and access routines for a greater number of data bases, consistent with its greater processing and on-line storage capacity. The central gateway machine can be shared by many libraries, making it economical and practical for even a very small library to use several hundred external bibliographic data bases.

THE LOCAL AUTOMATION MODEL PROJECT

The discussion to this point has been general in nature: broad characteristics of technical libraries, bibliographic networks, and library functions and processes. The following is a description of an on-going project sponsored by the Defense Technical Information Center of the U.S. Department of Defense. The objective of the project is to demonstrate the concept of a fully integrated library system for technical libraries, combining local library functions with capabilities for participation in a Department of Defense-wide bibliographic network.

Background and Environment

There are over 200 technical libraries and information centers located throughout the United States supporting the DoD research centers and laboratories conducting research projects. While the technical libraries all operate within the Department of Defense, each library is unique in responding to the management direction and patron needs of the laboratory or research center it supports. Each library reflects the emphasis and orientation of the research work supported, resulting in a wide range of library sizes, a variety of operating conditions and methods, and diverse, unique local collections. What these libraries have in common is the need to integrate bibliographic resources from three distinct sources. First, each library maintains a local collection consisting largely of scientific and technical reports (some of which are classified and restricted in availability), books, serials, and journals. Second, all retrieve citations and order copies of technical reports from a central source within the Department of Defense -- the Defense Technical Information Center (DTIC). Third, these libraries search and retrieve from commercially available bibliographic data bases containing information on science, technology, engineering, and other general research areas.

The Defense Technical Information Center is the information clearinghouse for scientific and technical information within the Defense Department /10/. In addition to operating an on-line catalog -- the Technical Reports (TR) data base -- of citations to over 1.5 million titles, the Center actively seeks ways of improving the flow of bibliographic information within and into the Department of Defense. To this end, the Center sponsors and conducts research and development in areas of information cataloging and indexing, storage, and retrieval. With the objective of speeding access to scientific and technical information, DTIC sponsors research in organizational programs and complementary computer-based tools for resource sharing within the Defense community. These include (1) development of on-line data base directories (metadata), (2) common command language-driven access to external commercial and government data bases via intelligent gateways, and (3) a shared cataloging program encompassing technical reports produced within the Department of Defense.

Defense Department technical libraries fill two important roles in promoting timely dissemination of current research results. Naturally, the technical libraries support their patrons with traditional reference services: bibliographic searches, preparation of research bibliographies, and development of project reference material. In addition, many technical libraries are charged with distributing technical reports and studies prepared by the staff of the laboratory or research center supported by the library.

In general, publications originated by the supported laboratory or research center are cataloged and shelved at the supporting technical library. Working in conjunction with the Defense Technical Information Center, the libraries are contributing directly to the centrally maintained TR data base through shared cataloging. This program is called the Shared Bibliographic Input Network (SBIN) /11/. Since fiscal year 1982, this program has accounted for about seven percent of the document citations entered in the TR data base. Since fiscal year 1982, the number of sites participating in the SBIN program has grown from 30 to 71, yet the level of input remains about the same: 1,800 to 2,200 citations per year /12/. It is estimated that SBIN sites could contribute anywhere from a third to a half of all citations entered in the TR data base /13/. This means more citations get into the central data base sooner, contributing to timely dissemination of technical information.

However, SBIN participation represents duplication of effort for most libraries: a citation is entered into a local catalog and then re-entered (in compliance with a different set of cataloging rules governing format and subject indexing) a second time into the TR data base. To promote shared cataloging, this duplication of effort must be eliminated or significantly reduced. The benefits of doing so are expanded, rapid access to new technical information.

Despite the diversity in organization, management, and patron orientation, technical libraries perform the same basic functions as any other library: cataloging, reference, and circulation management and control. A local collection, tailored to patron needs, provides the core resources. In general, all DoD technical libraries rely on the DTIC TR data base as the on-line reference source of DoD-related technical report citations. In addition, most libraries rely on commercial bibliographic sources -- DIALOG, BRS/SEARCH, LEXIS/NEXIS, OCLC, ORBIT -- and other government data bases -- chiefly NASA RECON and the Department of Energy RECON -- to meet patron demands for information. Regardless of the size, each technical library must maintain and exercise a range of bibliographic resources to meet patron needs.

Blending together the mix of resources required by Defense Department technical libraries complicates the process of developing automated systems to support library operations. While the process is further complicated by the nature of the local collection -- technical reports vs. monographs, restricted vs. open access to holdings -- there are clear advantages to pursuing integrated systems for technical library automation. Through integration, local collection access can be linked with access to external resources -- government or commercial -- providing a powerful reference tool well suited to meet the special demands of closed and open literature access.

Furthermore, the manual and intellectual effort spend on cataloging locally produced technical reports can be shared with other libraries through shared cataloging. That is, given that the citation is created and entered into a local catalog, the computer can be used to translate or reformat the citation (if necessary because of different catalog formats and cataloging rules) and transmit the citation to a central data base such as the DTIC Technical Reports data base. Once entered into the Technical Reports data base, other members of the technical and scientific community have almost immediate access to the latest research results.

Concept Demonstration

The challenge in developing and implementing automated systems for DoD technical libraries centers on integrating local collection management functions (reference, cataloging, and circulation) with access to external resources (both for reference and shared cataloging). This extends the concept of integrated library systems to encompass access to external resources. With such a system, library staff members can effectively and economically provide comprehensive, broad-based reference services taking advantage of diverse resources. Timely dissemination of current research results from shared cataloging by taking full advantage of local library resources and eliminating duplication of intellectual and manual effort in the cataloging process.

While defining the characteristics of an integrated system for technical library automation appears straightforward, a survey of existing software products indicates that no single commercial or public-domain system provides the capabilities needed to implement the concept. All the technology (software, hardware, and telecommunications) does exist, however. What is needed is an approach for modifying (as required) and assembling the available technologies into a truly integrated system running on one computer and accessible by any user over a single video display terminal. Development and demonstration of a system meeting these requirements became the objectives of the Local Automation Model project.

The Defense Technical Information Center initiated project development at the request of Shared Bibliographic Input Network member libraries. The shared cataloging experiment was burdening technical libraries because holdings (technical reports) had to be cataloged twice -- once in the local catalog and then again for the Technical Reports data base. While DTIC was benefiting from technical libraries' sharing cataloging responsibilities, the libraries appeared to bear a burden of effort disproportionate to the apparent benefits.

Serving as the focal point for the development effort, DTIC contributed a significant portion of the initial funding, supervised the day-to-day activities of the project, and coordinated the involvement of over twenty technical libraries. As such, DTIC shouldered the initial risk of project development, offsetting some of the burden placed on technical libraries already participating in shared cataloging. As a result, no single library would have to bear the risk of system development by itself, broadest possible user participation was encouraged, and scarce system development resources were focused on a problem likely to yield significant pay-offs throughout the Department of Defense technical and scientific community.

The primary objective of the Local Automation Model project is to demonstrate the concept of an integrated system handling performing local collection management functions, coupled with access to external bibliographic resources. The results of the project would be a local computer system available for implementation by SBIN member libraries. The project was structured in phases consistent with a typical automated system development life cycle: requirements definition, concept development, system design, concept demonstration, system acquisition and implementation, and system operation and maintenance. Work on requirements definition began in November 1982, with concept demonstration via implementation of a prototype system originally scheduled for June 1985.

Requirements definition began with visits to representative libraries to conduct interviews with staff members. A list of system requirements and features was prepared and included in a survey sent to 35 libraries participating in the Shared Bibliographic Input Network program. Twenty-five libraries responded to the survey. Respondents indicated the requirements and features considered essential for the system and ranked the requirements and features in order of priority of need.

On the basis of the requirements and priorities established through the survey, a design concept for the system was formulated. The design concept described the requirements to be included in the system and laid out a structure for the system. The design concept was documented and sent to survey respondents for comment **/14/**. Comments were taken into account in subsequent design work on the system.

Design of the system continued with development and publication of a Functional Description **/9/**. The purpose of this document was to convey to the user community and potential system developers the characteristics and performance of the system. Within the Functional Description, the software architecture for the system was defined. The operating environment was discussed, along with a statement of hardware features and characteristics needed to operate the system. The development approach for the remainder of the project was outlined in the Functional Description also. The technical library at the Defense Nuclear Agency in Alexandria, Virginia was designated as the test site for the prototype system. As before, the document was sent to participating technical libraries for review and comment.

At this point, the general system characteristics and capabilities were fairly well agreed upon. The processing steps and hardware and software requirements were then documented in a System Specification **/15/**. The System Specification described the detailed processing steps and sequences required to meet user requirements. Coincident with publication of the System Specification, modifications to the remainder of the development schedule were prepared and announced.

Initially, the system development plan called for demonstrating the system concept using a public domain library system widely known throughout the user community. The package had been modified and enhanced by a commercial vendor who was marketing the package. Unforeseen events halted pursuit of this approach and necessitated selection of an alternative development approach. The immediate problem in pursuing the alternative approach was selecting -- from perhaps hundreds of software products -- a system suitable for concept demonstration at the prototype site.

On the basis of the requirements and design documented for the system, a survey of available software products was conducted. The purpose of the survey was to ascertain the suitability of using existing, commercially available systems for the prototype. If existing software was found to be suitable for the prototype, it would reduce the risk and cost associated with developing software. A list of 30 critical functions was developed and used to conduct the survey. In all, 66 vendors were contacted and asked to respond the the survey points covering the 30 critical functions. In the first stage of the survey, 33 products were eliminated from consideration, leaving 30 vendors as possible candidates, pending further

evaluation. Of the remaining 30, six were finally selected as having suitable functionality and offering the requisite features for the prototype system **/16/.**

Performance benchmarking was used to select a package from among the final six for prototype system implementation. A test plan was prepared detailing the evaluation and scoring criteria used for performance benchmarking **/17/.** Several organizations provided staff members to participate in the evaluation. Each member of the team used the systems and evaluated them against the criteria listed in the test plan. Benchmarking took over 10 months to complete. The UNICORN System from SIRSI Corporation and BRS/SEARCH (Mini/Micro Version) were selected for the prototype.

To provide simultaneous searching of external sources and the local catalog, an intelligent gateway processor will be incorporated in the system. For the prototype system, a subset of the Integrated Information System (IIS) -- developed and supported by the Technology Information System group at Lawrence Livermore National Laboratory -- will be used. Lawrence Livermore staff members are participating in the prototype development, providing much of the technical and operational expertise required for software benchmarking, package selection, and, of course, integration of the intelligent gateway with local collection management functions.

With an intelligent gateway, users of the local system can be connected to several external systems and data bases via telephone lines. The gateway performs the protocol and syntax translation needed for intercommunication among dissimilar, heterogeneous systems and data bases. Coupled with a common command language -- via a custom-tailored user interface -- the gateway and the library software package are accessible by a user through a single video display terminal providing access to a broad range of information and data manipulation resources.

Progress and Future Development

Minicomputer-based System. Implementation planning for the prototype system began in February 1985 and continued through hardware and software installation. Installation of the hardware for the prototype system was completed in March 1986. Software installation and conversion of existing bibliographic and patron files was completed in April 1986. Training for the library staff was conducted concurrent with software installation and testing. Local system functions -- reference, cataloging, and circulation management and control -- are operational. Installation and testing of the gateway software and hardware will be completed this summer. The hardware configuration for the system is as follows:

- Digital Equipment Corporation VAX 11/750 central processor with six megabytes of real memory, running the UNIX operating system (version 4.2 BSD)
- Two 300-megabyte Winchester technology disk drives with removable head and drive assembles (for use with classified data)
- One 1/2" magnetic tape drive with selectable recording densities of 1600 and 6250 bits per inch
- One high-speed (300 lines per minute) line printer
- Seven VT100-equivalent video display terminals
- Three terminal printers, 200 characters per second print speed
- A secure, asynchronous, 9600-baud network linking the seven terminals and three printers located in the library with the central processor.

The prototype will be evaluated for a year. During that time, other functions may be added, modifications to improve performance and user access made, and other peripheral hardware tested. Experience with the prototype will shape performance requirements and specifications for the production system. Production system acquisition will be accomplished through a centrally managed, competitive acquisition conducted jointly by the Defense Technical Information Center and the Library of Congress Federal Library and Information Network (FEDLINK). The production system will be offered to Federal libraries and information centers, as are other FEDLINK products and services.

Microcomputer-based System. Beyond the 50 to 60 large technical libraries initially targeted by the Local Automation Model project, approximately 200 to 300 other DTIC users could participate in shared cataloging and benefit from gateway access features for reference work. The challenge becomes that of scaling the software and hardware so that a system -- with required features and capabilities -- is available for implementation within any size library or information center.

In April 1985, work began on demonstrating the functions and features of the Local Automation Model project on a microcomputer. Building on the results of the Local Automation Model project minicomputer prototype, system requirements and characteristics were established **/18/,** software packages were examined, and candidates were selected **/19/.** A prototype system was installed at the Headquarters, U. S. Training and Doctrine Command technical library at Fort

Monroe, Virginia. Operation of the local system functions began in March 1986, with implementation of gateway features scheduled for summer of 1986.

The microcomputer version of the system is implemented using the following hardware configuration:

- Altos 2086 central processor with 2 megabytes of real memory, running the Xenix operating system
- 80-megabyte Winchester technology disk drive with video cassette tape input and back-up
- Three IBM-PCs and one Wang PC configured as terminal work stations.

While prototype evaluation is well under way, other significant milestones remain. Some of these are readily accomplished within 6 to 12 months; others, because of greater complexity and broader impact, may take longer.

Production System Acquisition. A plan for acquiring the production system must be developed which accommodates the organizational and managerial diversity found in the DoD technical library community. The acquisition strategy must emphasize competition among the host of potential vendors, but must promote open access to technical data covering protected software so that integrated products can be delivered.

Expanded Gateway Access. Transferring citations between the local system and the DTIC TR data base -- both uploading and downloading -- is sufficient for concept demonstration. In practical application as an integrator of all library bibliographic resources, the system must offer the capability of connecting with and downloading citations from other sources. Expansion of the gateway features of the system to include access other government and commercial data bases is necessary.

Common Command Language. Hand-in-hand with the need to expand gateway access to other sources is the need for a common command language across all resources. Each government and commercial data base has peculiarities that confound command standardization. And each system's unique features may be accessible only through a unique command. However, as access to bibliographic resources expands, the need for even a "lowest common denominator" command set will increase. User demands and economic incentives will guide most commercial suppliers to a common command set or language, if a standard exists. Work by the NISO Z39-G Standards Committee is encouraging in this area **/20/.**

Reduction of Manual Effort. The key to further reductions in manual effort will be found in the use of optical character and bar code readers and in full-text scanning machines. Bar coding and OCR offer the potential for further labor saving in the area of circulation and inventory management. The ability to by-pass the key entry of information through use of image or text scanning will speed cataloging and enhance retrieval by encouraging full-text cataloging. Of these, the integration of bar coding offers immediate benefits to users in Defense Department technical libraries.

Full-Text and Optical Disk Technology. Sharing classified or proprietary information requires special safeguards which affect automated system design and operations. Telecommunications safeguards are expensive and in some cases economically unjustifiable for low-volume transaction rates. Rather than distributed processing of classified or proprietary bibliographic information over telecommunications networks, catalogs can be distributed on optical disk. Given sufficient production volume, copies of large data bases can be inexpensively produced and distributed on optical in a form suitable for rapid searching and retrieval. With optical disk distribution of data bases, can also have access to the full text of technical reports, rather than relying on traditional distribution of hard-copy and micro-fiche media.

Indexing Standardization and Controlled Vocabularies. A standard or common set of index terms and controlled subject terms will be beneficial for shared cataloging and retrieval within DoD activities and organizations. A vocabulary exists today and is in use by DTIC. Technical libraries argue that the terms are too broad for use in local collection cataloging where a single DTIC term can cover 10 to 25 percent of a local collection's holdings.

SUMMARY

Essentially, the implementation of the prototype systems by the U.S. Department of Defense demonstrates the feasibility of integrating diverse, yet functionally compatible local and bibliographic network resources for technical libraries. Ensuring widest possible access to the results of the Local Automation Model project -- access to production systems acquired as a result of project research and development -- enables individual technical libraries to improve patron services with a reasonable rate of return on system costs and without the risks of going it alone. For the Department of Defense scientific and technical community, implementation of the production systems provides a powerful information management tool supporting timely, comprehensive research, development, and engineering.

The development project sponsored by DTIC has broken new ground in uncovering and resolving the problems associated with technical library automation within the defense and aerospace community. Through the use of powerful, comparatively inexpensive microcomputers, it is possible to link local collection resources effectively and economically with a vast array of bibliographic network resources for any size library. The research results and experience with the

microcomputer-based prototype system are valuable lessons learned and can have a significant impact on how other organizations -- both government and private sector -- approach library automation.

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REFERENCES

/1/ Emily T. Smith and Evert Clark, "Now, R&D is America's Answer to Japan Inc.," Business Week, No. 2952, 23 June 1986, (Bus Week: ISSN 0007-7135, CODEN BUWEA), pp. 134-38.

/2/ Secretary of Defense Caspar W. Weinberger, Office of the Secretary of Defense, "Annual Report to the Congress -- Fiscal Year 1987," 5 February 1986, p. 313.

/3/ Martha E. Williams, "Electronic Databases," Science, Volume 228, No. 4698, 26 April 1985, (Sci: ISSN 0036-8075, CODEN SCIEAS), p. 445.

/4/ James E. Rush, Library Systems Evaluation Guide--Public Service, Volume 3, James E. Rush Associates, Powell. Ohio, 1983.

/5/ Richard W. Hartt and Dennis J. O'Connor, Logistics Management Institute, Microcomputer-based Local Automation Model: Test Plan, 31 January 1986, Task No. DL503.

/6/ V. E. Hampel, S. K. McGrogan, L. E. Gallo, and J. E. Swanson, "The LLNL Meta-machine: A Flexible, Extensible and Practical Technique for Interactive Data Management, Modeling and Distributed Networking," 4th Berkeley Conference on Distributed Data Management and Computer Networks, (also published by Lawrence Livermore National Laboratory as Report No. UCRL-83064), August 1979.

/7/ V. E. Hampel, R. Barker, M. C. Berch, et. al., "TIS: The Intelligent Gateway Processor," Proceedings of the Eighteenth Annual Hawaii International Conference on System Sciences, 1985.

/8/ Michael. C. Berch, "The UNIX Connection," Unix Review, May 1986, (UNIX/World: ISSN 0739-5922), pp. 44-53.

/9/ Walter P. Hamilton III, Richard W. Hartt, and Dennis J. O'Connor, Logistics Management Institute, Functional Description: Local Automation Model, September 1983, Task No. DL302.

/10/ Under Secretary of Defense for Research and Engineering, "DoD Scientific and Technical Information Program," U.S. Department of Defense Directive 3200.12, 15 February 1983.

/11/ Gladys A. Cotter, Defense Technical Information Center, The Shared Bibliographic Input Network (SBIN): A Summary of the Experiment, May 1983, DTIC/TR 83/5.

/12/ Gretchen Schlag, Defense Technical Information Center, management review summary statistics prepared for the Resource Sharing Advisory Group meeting held 2 and 3 April 1986.

/13/ Office of the Assistant Inspector General for Auditing, Department of Defense Inspector General, "Report on the Audit of Input into the Defense Technical Information Center Technical Report Data Base," 8 November 1983, Report No. 84-007.

/14/ Walter P. Hamilton III, Richard W. Hartt, and Dennis J. O'Connor, Logistics Management Institute, Local Automation Model: Conceptual Design Document, April 1983, Task No. DL302.

/15/ Walter P. Hamilton III, Richard W. Hartt, and Dennis J. O'Connor, Logistics Management Institute, Local Automation Model: System Specification, February 1984, Task No. DL401.

/16/ Walter P. Hamilton III, Richard W. Hartt, and Dennis J. O'Connor, Logistics Management Institute, Local Automation Model: Assessment of Library Software Availability, September 1984, Task No. DL401.

/17/ Walter P. Hamilton III, Richard W. Hartt, and Dennis J. O'Connor, Logistics Management Institute, Local Automation Model: Software Benchmarking Test Plan, March 1985, Task No. DL401.

/18/ Richard W. Hartt and Dennis J. O'Connor, Logistics Management Institute, Microcomputer-based Local Automation Model: Functional Description, October 1985, Task No. DL503.

/19/ Richard W. Hartt and Dennis J. O'Connor, Logistics Management Institute, Microcomputer-based Local Automation Model: Evaluation of Library Software, October 1985, Task No. DL503.

/20/ Charles R. Hildreth, Presentation at the American Society for Information Science (ASIS) Annual Meeting, 24 October 1985. A draft of the proposed standard for a bibliographic retrieval command language is available from NISO.

APPENDIX

REFERENCES TO LIBRARY SOFTWARE AND EVALUATIONS

These references contain lists of library software and vendors and reviews of library software. The references cover software suitable for local collection management: acquisition, cataloging, retrieval, and circulation management and control. Other applications of general interest to libraries, such as word-processing, are covered, but not as extensively. The serials referenced have a practice of featuring reviews of library software in each issue. Therefore, no issue or volume numbers are given. These serials are indexed in a number of on-line data bases in the United States.

James E. Rush, Library Systems Evaluation Guide--Public Service, Volume 3, James E. Rush Associates, Powell. Ohio, 1983.

Jeanne Nolan (ed.), Micro Software Report: Library Edition, Volume II, Westport, Connecticut, Meckler Publishing, July 1983.

Jeanne Nolan (ed.), Micro Software Report: Library Edition, Volume III, Westport, Connecticut, Meckler Publishing, 1985.

Jeanne Nolan (ed.), Micro Software Evaluations, Westport, Connecticut, Meckler Publishing, July 1984.

Library Software Review (Libr Software Rev)
Formerly (until 1984): Software Review (Westport): ISSN 0278-2634
Ed. Nancy Jean Melin
Publisher: Meckler Publishing
11 Ferry Lane West, Westport, CT 06880, Tel. 203-226-6967
ISSN: 0742-5759
CODEN: SSORD8

Library Journal (Libr J)
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Application of LAN's and Electronic Office Techniques in the Library

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Summary

The local area network (LAN) is a method of connecting computers and peripherals at very high speed. The technology has been under development since the early seventies and started to become commercially available about 1980. Commercial development accelerated in the early eighties as microcomputers became used for business and professional purposes. Microcomputer LAN's are now a major sector of the office automation industry. This paper reviews the technology and leading types of microcomputer LAN and explores how the technology can be integrated with existing library systems.

Normal office automation applications such as word processing, database management, spreadsheets and accounting systems can be implemented in a networked mode. Networking provides the additional benefits of connectivity and resource sharing. In the library context networking is particularly important for electronic mail, information transfer and information sharing. There is potential for integrating downloaded information from external databases into local systems.

Office automation applications are fundamental to library and information management. Systems may be seen as sources of management information as well as a medium for transmission. An effective automated office is in effect a decision support system. An automated office is also composed of people, and the introduction of such pervasive technology is complex. Attention must be paid to the human factors which as yet are little understood.

INTRODUCTION

Office automation is the subject of considerable current controversy and debate both generally in the world of business and commerce and increasingly amongst librarians and information professionals. This is occasioned by the wide availability of information technology systems and software products, particularly those at relatively low cost , coupled with the widespread belief that a revolution in office and related work is now under way. The foundations for development of office automation were laid during the 1970's as computers became more common and were applied to new applications. This trend accelerated in the early 1980's with the appearance of the low cost microcomputer and the realisation that microcomputers could be used not only for playing games but for serious business purposes. A notable example of this was the development of the program Visicalc for Apple II computers which alone was responsible for selling tens of thousands of that machine (1). There are now available for microcomputers many programs which are applicable to office work and which perform more satisfactorily in terms of design, flexibility, range of features, processing power and user friendliness than programs implemented on more expensive systems. In the course of ten years we have moved from a situation in which only large organisations can afford a computer to one where even small organsations can afford several and the purchase of a microcomputer is barely more remarkable than acquiring a typewriter.

The term "office automation" however has an important connotation which distinguishes it from earlier computer developments. It implies that it is possible to automate not only a job, a process, or a group of routines but a whole working environment. The term implies that one is implementing not just an automated system but a framework of great flexibility and adaptability capable of coping not only with the technical problems of the many and varied tasks involved but also the human factors. It is clear that whilst the potential of office automation is immense the attendant problems are little understood and experience limited.

The underlying trends which have led to the present market situation are well recognised. In hardware we continue to see phenomenal reductions in the cost of storage and processing power. Software packages achieving a mass market are very cheap and are increasingly friendly and easy to use. In communication technology transmission speeds are rising, transmission is being digitised, mixed media networks are developing and very high speed local networks are a reality.

These trends are mirrored in the development of library and information systems. Librarians have a strong record in adopting computerisation, starting in the UK and USA in the mid-1960's and very considerable investment has been made over the years. This investment however has been almost entirely directed to library housekeeping systems, that is, to systems aimed at managing and controlling collections of print. The first applications to be automated were those where the greatest savings or the greatest improvement in service were envisaged, such as circulation and cataloguing. With the appearance of low cost personal

computers it became possible to automate on a much wider scale activities beyond those directly concerned with book control such as word processing, report generation, small database management, spreadsheet manipulation and information sheets. These aspects of office automation are directly relevant to library and information work. The personal computer also offers the prospect of making the link between the generation of information within the library or information unit and the exploitation of information retrieval from external resources. This link is crucial in the transition from library and office automation to information management. It is now feasible for the information professional to download information from remote databases, store it, reformat it if necessary, incorporate it with other information, deliver it to the user in an acceptable form and account for the whole process using a desk top computer. As has been stated recently, technology is not the problem (2). The problems are associated with developing a strategy, implementing relevant applications in a co-ordinated manner, gaining experience and designing systems with attention to human factors.

LOCAL AREA NETWORKS (LAN's)

A number of definitions have been proposed but I will use the following simple definition for the purposes of this paper:

A local area network is a method or a system for connecting computers, peripherals and communications devices at high speed within a restricted locality.

For a fuller discussion of definitions see Collier (3). Terms related to local area networks are local networks, campus networks and microcomputer networks. It is something of a problem that these and other terms are used on occasions to convey subtle differences and on other occasions are just used vaguely and indiscriminately. Broadly speaking these terms have the following implications:

Local network: a network restricted to a certain locality but not necessarily conforming to the full requirements of a LAN

Campus network: a network developed for a university or similar institution which may well combine a variety of LAN's and other networking techniques

Microcomputer network: a LAN designed specifically for microcomputers and often a proprietary product restricted to certain brands of computer.

The most important element in the definition of a LAN is high speed. Transmission speeds quoted for LAN's range from 0.1 to 100 megabits per second with the majority of current products operating at between 3 and 10 megabits per second. Transmission speeds are therefore being achieved which approach the internal data transmission speeds of computers. LAN's are of fundamental importance to the productivity of the data processing environment as they remove the bottlenecks inherent in earlier communications technologies. It is the high speed operation of LAN's which distinguish them from the public switched network typically working at 9600 baud and the private branch exchanges working at about 64K baud. Because the technology required to achieve the high speeds of LAN's has not been available on the public switched network LAN's have been restricted to localities which can be wired up without the involvement of the national telecommuncations agencies. Since the term local area network was coined the term wide area network (WAN) has appeared, to describe the slower long distance communications which conform to nationally and internationally agreed protocols. National telecommunications agencies are now beginning to supply services offering higher speed transmission, such as British Telecom's Kilostream and Megastream. There is heavy investment in fibre optic cabling and satellite installation to provide broadband facilities of great capacity at a reasonable cost. When these services come into common use the need for a distinction between the local and the wide area network will disappear.

BRIEF BACKGROUND TO LOCAL AREA NETWORKS

LAN's began to come to the attention of the popular and business computing press in 1980-81. Very rapidly the trickle of press notices swelled to a flood of information, misinformation and commercial hype in which many exaggerated and premature claims were made. LAN's had however been developing for about 10 years previously in the academic and industrial research environment. A very early project which has been cited as significant in LAN development was the Aloha network which used packet switching techniques to connect by radio computer centres of the University of Hawaii, Subsequently a research team was set up at the Xerox Palo Alto Research Centre in the early seventies. In 1976 the now seminal description of Ethernet was published (4). The present ubiquity of Ethernet products is a tribute to the commercial far-sightedness and boldness of Xerox which in 1979 agreed to cooperate with DEC and Intel on production and marketing. Together they published the Ethernet specification in the hope that it would become a de facto industry standard. Saving the long awaited and no doubt crucial IBM entry into the mainline LAN market there is no doubt that the Xerox consortium's strategy on Ethernet has paid off.

Parellel to the US research on Ethernet there was a local area network project at the University of Cambridge in UK which developed the other most well known product: the Cambridge Ring (5). This network has also made the transition from the research laboratory to the commercial market albeit on a much smaller scale. A number of manufacturers market components and total systems to Cambridge Ring specification , which has become virtually a standard for UK polytechnic and university campus networks.

When LAN's came to the attention of the general computer market several companies suddenly discovered that they had been selling LAN's for some time. One firm which had a particular right to this claim was Datapoint who had been marketing ARCnet since the seventies. ARCnet is a true LAN but hitherto had not been called such.

The impetus for the rapid commercial development of LAN's in the eighties was the recognition of the potential of personal computers for office automation. LAN's for popular business microcomputers have now been used effectively for about four years and it is predicted that the number of LAN-connected computers will exceed 1 million by 1989 (6). There is still relatively little experience in libraries, however. The topic has begun to appear in the library and information science literature (7,8,9) and there is a dedicated newsletter Netlink published by Aslib, the Association for Information Management.

REASONS FOR INSTALLING A LAN

It has been said that some people seek out microcomputers whilst others have them thrust upon them. The same is likely to be true of LAN's as they become more common in library and information units. Procurement of a LAN could, for instance be a corporate decision within the organisation to adopt a network based approach to data processing and office automation of which library and information functions are a part. Alternatively the decision might be taken at library or departmental level to install a limited scale LAN linking personal computers which is then extended in response to service needs and demands from other users and departments. Whatever the political circumstances there are numerous reasons for adopting a LAN approach including:

Resource sharing

Devices such as hard disks and printers can be shared between several workstations. This is especially useful where the more expensive peripherals are involved. It is generally not worth sharing a cheap dot matrix printer as the network interfacing could cost as much as the printer itself. But when large hard disks or letter quality printers are in use capital and maintenance expenditure can be reduced by sharing these resources and, when use is intensive, productivity can be increased by re-routing work to other peripherals.

Improving access

A networked approach to information processing will encourage and facilitate access both to locally held files and to remote databases. Switching facilities can be provided which at a keystroke will connect the user to other devices on the network or to the wide area network.

Information exchange

Ease of access helps the user to appreciate the value of information collected or held elsewhere and encourages a cooperative attitude to making information available to others.

Exploiting and harnessing initiative

It is envisaged that many networks will be installed after considerable expertise has already been gained by individuals equipped with their own personal computers. The energy and productiveness of individuals can be channelled for the benefit of the organisation as a whole.

Control

The establishment of a LAN standard could also be an effective method of preventing non-standard acquisition of equipment and uncoordinated software development.

Linking of incompatible equipment

The gradual development of LAN standards particularly Ethernet, and no doubt the IBM network in due course, offers the prospect of relatively open systems in which the network provides a variety of interfaces thus enabling easier interconnection of other otherwise incompatible machines.

Integration of communication media

With the increasing digitisation of voice and images it is gradually becoming feasible to integrate text, data, images, television and facsimile using the same broadband network. Multi-media systems are available but are still expensive.

Building and planning

For some time architects have been advised to take data wiring into account when designing new buildings (10). Library managers might well take advantage of the opportunity afforded by the commissioning of a new or refurbished building to install the LAN at the same time. This was done recently at Reading University Library in UK (11).

THE COMPONENTS OF THE LAN

Computers and workstations

Starting with the devices which are most important to the user, the vast majority of workstations are ordinary microcomputers. A number of networks (e.g. Corvus Omninet) are designed specifically also for high quality wordprocessors. The workstation can be any intelligent device and may be highly specialised, for instance computer aided design (Apollo Domain) and image processing. In the library context a barcode reader would represent a special purpose workstation. In most library and information management applications, however, a standard personal computer will be the typical workstation.

Connection medium

The connection medium is the physical cable connecting devices on the network. Many networks use ordinary telephone cable (also known as twisted pair) which is cheap and durable but is less reliable over distance, is susceptible to environmental noise and possibly less secure against electronic surveillance. Increasingly networks are employing coaxial cable similar to that used in closed circuit and cable television. Although more expensive and less pliable than twisted pair its insulating shielding gives protection against environmental interference and when used in broadband systems has the capacity to support image, voice and data transmission. Still in its infancy is the use of fibre optic cable, which has immense capacity and is totally unaffected by electromagnetic interference. At present however production and installation costs are high but it is expected that costs will be reduced in due course. A highly ambitious and technically very successful fibre optic network has been implemented in London using underground fibre optic cable. The system provides interactive television demonstration and teaching facilities across several sites of the Charing Cross and Westminster Medical School (12).

Network interface

All networks have a communications device which links the workstation to the connection medium. Each product has a proprietary name for the interface such as "transceiver" or "network interface unit". These may be external black box units or add-on boards or cards installed in the workstation.

Servers

The server concept is unique to the local area network field and as its name implies provides a service function to shared devices such as hard discs or printers. A print server or file server will allow and control access by user workstations to the shared device and in the case of file servers will often carry out file management and network software control. In microcomputer networks the server may be a dedicated microcomputer or a user workstation may fulfill the dual role. The size of mass storage units available for microcomputer networks is now measured in hundreds of megabytes.

Gateways

The gateway is a concept common to both local and wide area networks. It is an intelligent device located on a network which gives automatic access to another network. Devices range in sophistication from auto-dial modems which many libraries use for access to remote hosts, to dedicated computers providing various protocols and transparent connections. The gateway is an important requirement for a microcomputer network used in library and information management as it extends the scope and power of the information manager's workstation easily and without the need to move to specialised equipment.

SYSTEM MANAGEMENT CONSIDERATIONS

Topology

The layout of the connection medium is the physical manifestation of the network topology. There are three basic configurations, the star, bus and ring. The star network is the traditional topology of the centralised computer network and consists of wires radiating from a single point. A star network has the virtue of simplicity but is expensive in cable and is susceptible to failure of its central component. The bus network takes the form of a tree with branches, is less susceptible to failure of a single device, is easily expandable and is economic in use of cable. A ring network takes the form of a closed loop with stations placed at intervals round the loop. It has similar advantages as the bus network over the star network but is not such a widely favoured topology.

Protocols

The success of local area networks is owed to the development of sophisticated protocols which allow vast amounts of data to be transmitted with minimal occurrence of errors. Whilst the connection medium determines the bandwidth it is the access protocol which controls data transmission and error checking. The most common types of access protocols in high performance LAN's are as follows:

Empty slot

In this method slots or electronic data receptacles circulate around the network and are checked by the workstation. If empty they can be filled with data for transmission to another workstation. This is the method employed by the Cambridge Ring.

Token passing

Tokens circulate round the network indicating whether the network is free for transmission. If so the workstation transmits its message. This is the method employed by ARCnet and PLAN 4000.

Carrier-sense Multiple Access (CSMA)

In this method workstations listen to the network and if it is clear they are free to transmit. Contention between stations is not normally a problem but can be avoided by collision detection (CD) techniques and collision avoidance (CA). This method is used by Ethernet networks.

The most common access protocol is CSMA but this may change as a result of IBM opting for token ring as its main system for the future, There is considerable debate among the specialists as to the advantages, disadvantages and relative efficiency of the various protocols.

Distributed processing

Many of the management advantages cited for LAN's relate to the fact that they provide a distributed processing environment. This means that data processing is carried out simultaneously by various computers on the network, as opposed to the situation in a centralised processing environment where users share a central processor. To take an example from the information management field, consider a library which wishes to run a multi-user information retrieval package. The librarian has the option of using a multi-user machine (say a minicomputer) or using a microcomputer LAN. In the minicomputer solution the users rely on the availability of the central processor and its associated peripherals. If it fails they stop work. In the microcomputer LAN solution the user will load the retrieval software from the network in to the personal workstation. The workstation runs the software locally whilst accessing files on the network file server. If the file server fails the user switches to another file server. If the network fails the user continues work accessing local hard or floppy disk storage. The network is therefore inherently less susceptible to central failure and is said to be resilient. Dividing the processing between individual workstations is more flexible as stations can be reconfigured or reassigned to different tasks at will. The network is expandable as additional workstations can be added easily and cheaply as demand grows. Finally and very importantly the microcomputer LAN allows total personal control by the user over the work in hand. There is no remote computer centre imposing apparently unnecessary operating conditions. It has been observed that in successful office automation implementations users can develop a high degree of enthusiasm and involvement through controlling their own workstation and realising its potential, often far beyond what was anticipated (13).

These are some of the advantages that might be expected from the distributed processing environment of the LAN. This is the theory at least for as yet real experience is very limited and - as far as library and information management is concerned - almost non-existent. What is clear however is that if the introduction of a computer is a great technical, organisational and managerial challenge then introduction of a network of computers is even more demanding for all those involved.

SOME LEADING MICROCOMPUTER LAN's AVAILABLE IN USA AND EUROPE

Product mane	: PLAN 2000, 3000, 4000
Manufacturer	: Nestar
Type	: Token passing
Speed	: 2.5 Mbs
Further information	: Products start with low-cost network for 2-6 IBM PC's with progression on the PLAN 4000 to 255 PC's with over 500 Mb store.
Product name	: Etherseries
Manufacturer	: 3COM
Type	: Ethernet CSMA/CD
Speed	: 10 Mbs
Further information	: Can support up to 1,024 IBM PC's over 1,000 feet of cable. IBM PC compatibles e.g. Olivetti M24 supported.
Product name	: IBM PC Net
Manufacturer	: IBM
Type	: CSMA/CD
Speed	: 2 Mbs

Further information : Can support up to 72 PC's on 1,000 feet of cable.

Product name : 3M Model 73000 LAN/PC
Manufacturer : Interactive systems/3M
Type : Broadband 5 channel. Novell Netware,
Speed : 2.5 Mbs
Further information : One of a range of products for small to large systems. A wide range of gateways available. Total nodes supported 1,275.

Product name : Omninet
Manufacturer : Corvus
Type : CSMA/CA
Speed : 1 Mbs
Further information : Supports up to 64 nodes along 4,000 feet of cable.

Note. There are now numerous general introductions and textbooks on LAN's. A good up to date account of microcomputer LAN's is given by Magid and Boeschen (14).

LAN's AT WORK IN LIBRARIES

The commercial library computer market has been and remains largely dominated by the minicomputer based commercial products and cooperatives targetting the medium to large libraries (15). So far LAN technology has had little effect on the design and systems architecture of these systems. It is argued that many functions such as circulation, cataloguing and serials control in large organisations lend themselves to a centralised processing approach. There is moreover little incentive for the minicomputer orientated library systems houses to redesign their systems given the complexity of distributed data processing. There are signs however that institutions are developing LAN interfaces to their library computers in order to expand their accessibility to other terminal sites. A LAN interface to a GEAC system is reported in USA (16) and linking of campus networks to library computers is becoming popular in UK. Reading University have connected their SWALCAP system to the campus network (17) and at Leicester Polytechnic campus network users have access to the BLCMP online public access catalogue.

Developments are rather more dynamic in the microcomputer LAN field, for it is in expanding the capability of microcomputers for lower budget libraries that LAN's really offer the greatest potential. Companies which started offering single user microcomputer packages and multi-user microcomputer systems to libraries are now moving into the LAN field. Levert in 1984 listed eleven microcomputer LAN projects in USA and UK (18) and this base is gradually increasing. At the time of writing the author knows of only one library systems house, Data Trek,which has a substantial user base in a LAN environment. Data Trek has approximately thirty integrated library systems operating in the LAN environment including sixteen on CP/M machines and fourteen on MS/DOS. Of the fourteen MS/DOS networks, thirteen are using Novell Data Systems Netware and one uses 3COM's Etherseries (19). It seems likely that any new installations will be in MS/DOS rather than CP/M environments. Many microcomputer LAN implementations in libraries are still isolated developments for specific activities or for research and development projects. Some examples are given below. It remains to be seen how long it will be before the large systems houses acknowledge the importance of small microcomputer network based systems and invest some of their capital and market power in developing the small and special library market.

SOME LAN IMPLEMENTATIONS IN LIBRARY AND INFORMATION UNITS

Note: Figures in brackets after the institution's name refer to items in the list of references.

Ethernet

California Institute of Technology, USA (20)

Manufacturer : Ungermannn Bass
Applications : Terminal access to library mini
File transfer
Electronic mail
Connection to remote hosts

Xerox Palo Alto Research Centre, USA (21)

Manufacturer : Xerox
Applications : Electronic mail
Facsimile
Connection to remote hosts

Leicester Polytechnic, UK

Manufacturer : 3COM Etherseries
Applications : Office automation

Cambridge Ring

Reading University, UK (22)

Manufacturer : Camtec

Applications : Connection to WAN
Terminal access to library mini source

Leicester Polytechnic, UK

Manufacturer : Camtec

Applications : Online Public Access Catalogue (OPAC)

Novell Data Systems Netware (23)

Molycorp USA

Manufacturer : Novell

Applications : Integrated library system - Data Trek

Note : Source quotes thirty Data Trek systems running in a LAN environment.

Omninet (24)

Coventry Lanchester Polytechnic, UK

Manufacturer : Corvus

Applications : Office automation
Spreadsheets

IBM PC Net (25)

Department of Information Science , University of Strathclyde, UK

Manufacturer : IBM

Applications : Office automation
Information management
Information Science Teaching

PLAN 4000 (26,27)

Polytechnic of Central London, UK

Manufacturer : Nestar

Applications : OPAC research
Office automation

Televideo (28)

Houston Academy of Medicine, Texas Medical Centre Library, USA

Manufacturer : Televideo

Applications : Office automation

OFFICE AUTOMATION AND INFORMATION MANAGEMENT

Whilst LAN's are being used for a wide range of applications and with all levels of computer hardware they are seen as particularly appropriate for microcomputer based office automation. Personal computers because of their low cost and wide range of software are already extremely popular and this will increase. The local area network enhances the provision of personal computing with connectivity and resource sharing. By connectivity is meant the ability to pass messages, programs, text and information between users. By resource sharing is meant the ability to share expensive peripherals such as mass storage devices and high quality printers but also, and more importantly to share the creation, storage and retrieval of information. Without this connectivity and resource sharing it is debatable whether an office containing several individual stations should be said to be "automated". The network is an important if not essential element of the framework that is office automation.

Office automation is more than the computerisation of specific tasks, it is the result of integrated planning aimed at increasing the effectiveness of the organisation. Since the vast majority of office time is spent processing information then effectiveness of the organisation depends heavily on how well information processing is managed. When rigorously examined a proportion of the work carried out by people thought of as non information workers is in fact information work. Strassman has estimated this at up to a quarter of their total workload (29). Increasing specialisation, proliferation of professional activities and constant demand for more data concerning organisational functions all contribute to the continuous growth of information activity. If this is true for a manufacturing enterprise it is even more so for library and information units the activities of which are dedicated entirely to retrieving, creating and disseminating information. Successful office automation must depend on careful planning but this is easier said than done owing to the great complexity of office activities. Office work and organisational bureaucracies tend to create activities which rapidly become self-fulfilling. This makes analysis of office functions hazardous and rarely satisfactory or conclusive. This has often been the experience in library work also and must represent part of the reason why

there has been little progress in the development of management information systems in libraries. I have been struck on a number of occasions by the vast difference between the ways the same activity is organised in two libraries. In one library substantial staffing resources and bureaucratic energy may be devoted to an activity whereas in the second library it may be handled in a simpler less resource intensive way. There is, however little discernible difference in the level of service provided between the two libraries. It has long been a watchword of library automation that only after careful analysis of the task concerned should the decision be made: whether to automate. We can now go further. Ubiquity and cheapness of office automation systems and products means that there is almost certainly something to be gained from automating the activity, but only after the activity has been rendered as simple as possible (30).

Since library and information units are concerned with information management, and very little else, and office automation is part of information management, libraries provide the scope for development of the office automation system par excellence. Libraries manage information for three main purposes:

Consumption by the user in the form of loans, enquiries and delivery

Consumption by the library for professional and service development

Consumption by the parent or funding organisation for management purposes

The information is made available through information management activities which include:

creation and collection within the library

retrieval from elsewhere

processing and tailoring for the user
merging and adding value

publicity and marketing

delivery.

Translated into software terminology these activities are supported by a vast range of office automation products. Apart from packages associated with text retrieval and online search strategies these are products which have been developed for the general high volume office market, are relatively inexpensive compared to dedicated library automation software but are applicable to libraries with little or no tailoring. It is impossible here to list products by name but they fall into the following categories:

Text and wordprocessing - applicable to document processing of almost all kinds but especially those involving update and revision. These packages can be extremely user friendly incorporating high quality graphical presentation, variable formats and iconic operation.

Database management - for records manipulation and retrieval where multi-faceted views and relationships are more important than response time

Information/Text retrieval - for record and text retrieval where search precision, keyword searching and response times are important,

Publicity - includes mailing list packages, computer typesetting, camera ready copy systems, page make-up and graphics.

Communications - includes electronic mail,online search assistance and automatic logging on.

Financial - accounting packages, purchase and sales ledgers, and financial forecasting.

Spreadsheets - for manipulation and multiple views of numeric data.

These packages have often been introduced into the microcomputer LAN market as single user packages. They are implemented and run on the users workstation whilst calling on a dedicated area of file server so although apparently operating in a multi-user environment the network is in fact running several single users concurrently. This operates quite successfully in many personal computing situations but has limitations for development of multi-access databases. Increasingly however specially designed LAN implementations are being produced for many packages. Information retrieval packages for microcomputer LAN's include TINman and Inmagic. It is now common also for packages to be bundled together for a packaged network and marketed as integrated office automation systems. Examples of this are Torus Tapestry for the IBM PC net and Open Access for Etherseries.

DECISION SUPPORT SYSTEMS (DSS)

Bundling of software to produce comprehensive information management is evidently a response to a perceived market demand for simplicity of operation and integration of data. It is a short step conceptually to turn information management systems into management information systems. It is desirable that information management activities should be self-monitoring and produce operational data so that the contribution, role and potential of the activity can be considered as objectively as possible as part of our overall aim to increase the effectiveness of the library. The short conceptual step however has been and remains some way ahead of practical realisation of decision support systems, at least in the library field.

Decision support as an idea has developed out of management information but emphasises the importance of the human decision maker in evaluating the data presented. Management information systems (MIS) have been in existence as long as managers but it is since the introduction of computerisation that the term has acquired its present significance. Essentially a management information system deriving data from computerised processes presents information according to rules and procedures which are already defined with the result that decisions are largely automatic and the need for further judgment limited. A good example of this in the library context are the historic file analysis and automatic variable loan policy software developed by SWALCAP in the mid-seventies. These systems usually extract data from circulation, cataloguing and to a lesser extent accession systems and provide detailed analysis of current events and past patterns (31). They have, however, failed to make a substantial impact on library decision making at least as far as is indicated by the literature. The problem of non-use of management information in libraries has been analysed elsewhere (32) but the following represent the major cited reasons:

a) The information output is often not discriminating, providing reports routinely when not required, resulting in an excess of information.

b) The information is not presented analysed for a particular purpose.

c) The information needs to be integrated with other data concerning the total system before it can be useful.

d) The information is not presented in a user friendly manner.

e) The information even if valid may not be accepted for personal, political or cultural reasons.

With recent improvements in computer power and software design it is now possible to rectify some of the problems limiting the effectiveness of MIS and appropriate features are appearing in products bearing the label of DSS. In order to clarify what is meant by DSS and define their role in relation to the human decision maker W A Freyenfeld (33) has produced the following definition:

"A DECISION SUPPORT SYSTEM is an interactive data processing and display system which is used to assist in a concurrent decision-making process, and which also conforms to the following characteristics:

i it is sufficiently user-friendly to be used by the decision maker(s) in person

ii it displays its information in a format and terminology which is familiar to its user(s)

iii it is selective in its provision of information and avoids exposing its user(s) to an information overload".

Freyenfeld goes on to identify six basic types of DSS. The Chief Executive Information System (CEIS) is highly individual concentrating not so much on detail but on issues concerned with validity of data, reliability of source and confidentiality. A Commercial Operational Analysis and Planning System (COAPS) draws on data from many sources, is relational in nature, is used at various levels of staff and offers forecasting, simulation and optimisation. An Industrial Operational Analysis and Planning System (IOAPS) tends to provide similar facilities but optimised towards production problems such as task control in changing situations and troubleshooting. The Preference Determination System (PDS) assists the user in decisions involving essentially subjective criteria inviting him or her to weigh preferences, analysing combinations of attributes and producing reports on options, weightings and final preferences. A Cognitive Mapping System (CMS) assists in understanding problems, breaking them down into interactive elements and "mapping" them graphically for consideration. An Expert Advisory System absorbs information to build a knowledge base and then applies rules to present advice to the user.

In practice (and it must be acknowledged that the practice is so far very limited and tentative) these areas overlap considerably and any DSS is likely to contain elements from any or several of these types.

Current packages labelled as DSS are often described as "Shells" within which an individual system is built. In terms of applications software it is likely that DSS will be very modular both in order to capture data from different sources and in order to manipulate and output them in appropriate formats. The applications discussed above in office automation such as wordprocessing, database management, spreadsheet manipulation, electronic mail and downloading have a place in DSS. The DSS is therefore at the heart of the automated office and there is a sense in which the fully developed automated office is itself a DSS.

The use of DSS is in its infancy and as yet is little explored in the library context (34). A recent search on DSS in libraries has produced a few references all of which relate to US experience. The literature is still predominantly of a theoretical nature (35,36). A monograph on library DSS is in the press (37). Libraries represent very large amounts of expenditure and enormous manpower effort often directed according to inexact data and subjective judgment. It is necessary that the possibilities of improved decision-making with the assistance of developing DSS should be fully explored.

THE HUMAN PERSPECTIVE

The aim of office automation is to increase the effectiveness of the organisation through reduction in routine workloads carried out by staff so that they can progress to take on new projects and challenges. Work which is routine to one staff member may present a new challenge to another. Implemented carefully electronic office techniques can improve communication which in turn improves the organisation. Excessive organisational complexity will tend to hinder measures aimed at improving effectiveness but excessive complexity, having evolved out of working practices, will often be deep-seated and proposals to simplify unwelcome. The introduction of office automation will be welcomed by some staff who will in general be high performance staff with a high level of self-motivation and who would do well and make the best of any working environment, This is not to say that those who do not welcome office automation are not high performance staff, far from it. They may indeed be wise enough to realise that the list of problems and pitfalls is almost as long as the opportunities. There are very real and understandable fears: fear of reduncancy, fear of feeling inadequate, fear of the unknown and fear of loss of job satisfaction and job devaluation. In the library context many staff and users fear the end of the library as we know it. Introduction of office automation is therefore a highly emotional experience.

It is unlikely that such changes can be introduced without discontent and apprehension but every effort should be made to avoid the worst effects by:

Sufficient advanced warning

Emphasis on the advantages and frank discussion of the disadvantages

Participation of staff in development

Training

Full commitment of management at all levels.

Commitment of senior and top management is twofold. Commitment and a readiness to use the technology is required from the senior staff as the benefits of reducing their own routine workloads are at least as great as for other staff. But there is an emotional dimension which the senior manager must accept also. Office automation is intrinsically a decentralisation of not only processing but also responsibility. The full benefits of decentralisation will only be realised if there is also a commitment to decentralisation of responsibility and decision making in order to develop fully the potential of each member of staff in the changed environment.

CONCLUSION

In some special information units the electronic library is already almost a reality. For public, governmental and academic libraries and other hitherto book based information management organisations the electronic library will not in the foreseeable future be bookless, any more than the automated office will be paperless. These libraries will however be electronic libraries in a real sense as their information activities will be almost exclusively automated and their sources will be electronic unless the economics of a particular publication allow print production. There will be no room for sentimental attachment to the printed medium if it is not the most effective way of bringing information to the users. LAN's and office automation techniques will be fundamental agents in this continuing period of change for they will allow the development of the multipurpose information management workstation. With this we would find information, reformat it, merge it with other information, distribute it to the user in an acceptable form and account for the entire process. Linked by the LAN and the WAN the librarian will maintain constant two way communication throughout the organisation and elsewhere. Librarians should be confident that substantial increases in library effectiveness, job satisfaction, user appreciation and personal development can be achieved in such an environment. Success will depend not on the technology itself but on the skill with which it is introduced and managed.

REFERENCES

1 Schuyler, M. The evolution of spreasheets. Microcomputers for information management 2 (1) pp.11-23, March 1985

2 Blake, N. Technology is not the problem. In Grieves, M. ed. Information handling and the office of the future: report of a seminar. London: British Library Research and Development Department, 1984.

3 Collier, M. Local area networks: the implications for library and information science. Library and Information Research, Report, 19. British Library Board, 1984.

4 Metcalfe, R.M. and Boggs, D.R. Ethernet: distributed packet switching for local computer networks. Communications of the Association for Computing Machinery, 19(7) July 1976. pp395-404.

5 Spratt, E.B. Communication between microprocessors: the Cambridge Ring. Electronic Technology v.14 Nov/Dec 1980.

6 Boss, R.W. Telecommunications for library management. Knowledge Industry Publications, Inc. White Plains and London, 1985 p.50.

7 Farr, R.C. The local area network and the library. Library Journal. Nov 1983 pp.2130-2132.

8 Mason, R.M. Should you consider a PC local area network? Library Journal June, 1985 pp.42-43.

9 Local area networks and libraries: the Los Angeles chapter of ASIS Seminar Proceedings. Ed. Wendy Culotta. Studio City: Pacific Information, Inc. 1985.

10 Hamilton, J. Architects plans should allow for data wiring. Computerworld February 27, 1984 pp.21-24.

11 Lovecy, I. A library implementation of a LAN. Vine, July 1985 pp.35-39.

12 Williams, A.R. Interactive television for distance learning. Journal of audio-visual media in medicine, 1985 v.8(2) pp.57-64.

13 Strassman, P. The information payoff: the transformation of work in the electronic age. New York, London: Free Press, 1985. p.64-76.

14 Magid, L.J. and Boeschen, J. The electronic link: using the IBM PC to communicate. Wiley, 1985.

15 Matthews,J.R. Growth and consolidation: the 1985 automated library system marketplace. Library Journal, April 1, 1986 pp.25-37.

16 Persky, G. et al. A Geac local area network for the Bobst Library. Library Hi Tech v.2(2) 1984, pp.37-45.

17 Lovecy op. cit.

18 Levert, V.M. Applications of local area networks of microcomputers in libraries. Information Technology and Libraries, March 1985 pp.9-18.

19 Cheatham, S. Data Trek and local area networks. (In ref. 9 pp.153-159)

20 Card, S. The use of LAN in an integrated library system (In ref 9 pp.116-120)

21 Lavendel, G.A. Big world in your net: a productivity story (In ref. 9 pp.121-129)

22 Lovecy op. cit.

21 Martin, J. Planning for and early experiences with a library LAN (In ref 9 pp.130-134)

24 Lines, L. Polytechnic library applications of a database management system using microcomputers linked to a hard disc. Program v.17(4) 1983 pp.217-232.

25 Gibb, F. Elan: an educational local area network. Forthcoming conference paper, Aslib.

26 Mitev, N; Venner, G; Walker, S. Designing an online public access catalogue. Library an Information Research Report, 39. London: British Library Board, 1985.

27 Collier, M. Microcomputer networks for library applications: research at the Polytechnic of Central London. Microcomputers for information management. v.2(1) 1985 pp.33-42.

28 Ralls, R. Office automation at the HAM-TMC. Unpublished communication. May 1983.

29 Strassman, op.cit. p.5

30 Strassman, op.cit. p.19

31 Clinic on Library Applications of Data Processing, 19. Library Automation as a source of management information. Urbana: University of Illinois, 1983.

32 Olsgaard, J.N. Characteristics of managerial resistance to library management information systems. In Clinic (op.cit.) pp.92-110.

33 Freyenfeld, W.A. Decision Support Systems, N.C.C. 1984

34 Wilson, T.D. Office automation and information services, LIR report 31. British Library Board, 1985.

35 Chorba, R.W. and Bommer, M.R.W. Developing academic library decision support systems. Journal of ASIS 34(1) pp.40-50, 1983.

36 Heindel, A.J. Decision support systems in libraries. Special libraries 4. pp.319-327, 1981.

37 Brophy, P. Management information and decision support systems in libraries. Forthcoming, Gower, 1986.

Microcomputers in Information Resource Sharing : 1 - Data and Graphics Systems

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Summary

The number of online numeric data sources now exceeds that of the bibliographic and full text systems. Most of the databases are of financial or economic data, but a significant proportion deals with scientific, technical and medical information, and environmental studies are well covered. Examples of North American and European sources are given, and issues of data quality and property rights are discussed.

The application of data from a shared source normally involves access in a language specialised to that database, and the subsequent use of flexible software to format and present the retrieved data. This final step may be done on the host system, using programs provided by the data vendor, but is increasingly being transferred to the user's micro computer, using either general purpose software, or micro computer versions of mainframe utilities.

The scope of analysis, tabulation and graphical presentation now on offer is considered, and the implications for choice of micro computer systems, and for information staff training and career development are considered.

Scope and context

Numeric databases, comprising quantitative data and a variable amount of supporting text, constitute the most rapidly developing growth area in on line data, both in Europe (1) and North America (2, 3). The major segment is financial and economic data, with estimates ranging from 80% to 90% of the vendors' revenue from this source. Taking the forecast in the LINK 1986 Report (1) of a European market for numeric data of US$ 1,845 million by 1990, even 10% in the 'other subjects' sector is over US$ 180 million - roughly the same as the total spend on bibliographic and full text sources combined, for the same year and the same market place. In Europe, the 'data' market is concentrated in UK, Switzerland and the Netherlands, quite unlike the 'full text' sector where France and UK are the main centres, with West Germany less important.

The financial and economic data is of direct relevance to most commercial and many public sector organisations, and most of the examples used below come from this field. It has also, however had a secondary influence – rather like the digital watch market on the economics of micro chip development – in stimulating the production of a wide range of general purpose software for manipulating, formatting and presenting quantitative data, much of it designed for micro computers. Current developments in the international commodity and money markets, based on improved communications and the increased volatility of trading, will no doubt continue to encourage software developers, who tend to think nowadays in terms of tens of thousands of sales of a 'package' product on micro systems, and hundreds of copies even of fairly specialised minicomputer products.

A distinction is made between 'full text' containing numeric data, such as the text of newspapers with financial statements, and data held in a form intended for further processing. The former is considered in some detail in the paper by John Gurnsey, while the present account is mainly concerned with data in 'raw' or partly interpreted form. There is an intermediate case where numeric data is retrieved as text, and transferred by the user into a processable form using local editing software.

This paper concentrates, therefore, on data retrieved in processable format, its handling on micro computers, and the importance of these processes for information services and libraries. Because of the nature of some of the data, it is also necessary to consider applications more specialised than an information scientist would, in general, undertake. A valuable, and more general account, from the standpoint of a university information retrieval specialist, and dealing mainly with services processed on hosts and delivered to user terminals, will be found in Meschel (2). The important, and quite large scale interchange of geophysical and well data among oil and gas exploration companies has also been omitted, partly since it usually requires minicomputer processing capability rather that micro computers, but more because it is an extreme case of data which makes sense only when both handled and interpreted by specialists.

Several directories are of value in looking for databases for a particular application, and those most consulted by the author are shown as references (4-6). For financial applications, a direct approach to the major vendors is probably the best way to get current information in a rapidly evolving market.

The author wishes to thank CiSi-Wharton Associates, Datastream International Ltd., and I P Sharp Asssociates Ltd., for providing data on their services, and especially acknowledges permission from Link Resources Corporation to draw on the LINK 1986 Report (1).

Data sources

The following selection of online data sources is only a tiny sample of those available, but is intended to illustrate the range of material now accessible.

Financial and commodity data:

CiSi-Wharton*	DATASTREAM #	I P Sharp §
World Economic Service	Share Indices	Commodities
Foreign Exchange Service	Exchange Rates	Currency Rates
Int. Agricultural Service	Interest Rates	Money Market Rates
Centrally Planned Economies	Euro-Currency	Currency Projections
Latin American Service	US Rates	US Company Data
Mexican Service	Japan Rates	US Exchanges
Middle East Service	Commodities & indices	Far East Exchanges
Pacific Basin Service	Oil prices	Energy Data
Economic News Perspectives	Company Results	Communications
* focus is *forecasting*	# focus is *economic data*	§ focus on *services*

(The lists are not intended to compare the performance of the three major services - that could only reasonably be done in considerable detail, and would probably vary with the standpoint of each individual user.)

Science and technology:

BASEENT (Entidades de Poblacion)

This factual database contains population and location data (mixed Spanish text and numeric) on townships in Spain. (Producer is IGN who are also the host)

EPIC (Estimate of Properties for Industrial Chemistry)

This is a database system that allows users to calculate thermodynamic properties of over 700 organic chemicals. Users may access stored data, temporarily modify data, or perform calculations on combinations of their own and stored material. (Producer is Textual-Numeric, Liege; system runs on CISI)

F*A*C*T (Facility for the Analysis of Chemical Thermodynamics)

This is a database system which allows users to perform a range of thermodynamic calculations on more than 3,800 inorganic compounds. (Producer is Thermfact Ltd.; system runs on CISTI, CAN/SND)

IRSS (Infrared Search System)

This is a database of about 5000 infrared spectra from EPA contracts and Boris Kidric Institute in Yugoslavia. Users may search by CAS Registry number, peak positions, partial and complete formulæ, and chemical structures. (Chemical Information Systems Inc.)

OECD DAC (External Debt of Developing Countries)

This numeric database contains time series and forecast data on the debt positions of 141 developing countries and territories. (OECD; I P Sharp)

SANSS (Substructure & Nomenclature Searching System)

More than 350,000 substances are recorded, with CAS name and registry number, and a connexion table showing molecular structure. Users search on molecular weight, formula, complete or partial structures, names or parts of names. (Producers are EPA, NIH)

UPGRADE

There are several databases under this general title covering environmental data. They are managed by Sigma Data Services Corp. for the Council on Environmental Quality.

The subjects are:

Aerometric Data
Water Quality data
National Stream Quality Accounting Network
National Emissions Data System

When factual information is retrieved the question of its reliability immediately arises. In the financial areas, original data on share prices and exchange rates is verifiable at leisure, even though the pressure for immediate information generally means that the user relies on the established reputation of the vendor. As we move from daily changes in easily accessible information in major financial centres, to projected and interpreted data on small and underdeveloped economies, the precision which is economically reasonable becomes less, and the margins for misunderstanding wider, so that the appraisals and evaluations provided by the data vendor require more attention, and the availability of such appraisals may be a significant factor in choice of a service.

In scientific and technical information, the value of precision and control of data is well appreciated, the cost of attaining such quality perhaps less so. Hampel (7) in 1981, quoted a figure of 'only' $6.8 million spent in 1977 on a US national programme to evaluate chemical and physical data, when at least twice as much might have been desirable. Based on studies of the compilation of the Joint Army Air Force (JANAF) Thermochemical Tables, he found a cost per single material property as a function of temperature and/or pressure of $1,000, and that the sources for such a data sheet would typically span ten publications. This estimate might now be increased by subsequent inflation to $1,600 or more, and excludes the very much larger sums expended in preparing the primary articles in the first place. There is at least anecdotal evidence that users prefer numeric databases which incorporate accuracy and quality assessments (2, and personal communications).

Now, one might expect that when so much investment is made in the data, the vendors would become possessive about its application and reuse, especially in view of the complexities which have arisen on copyright of both full text and bibliographic data from online sources. In practice, the compilers and vendors are rarely, apparently, much concerned with what happens to retrieved data, and appear to assume that it is, of its nature, going to be an information component of a further process. I P Sharp Associates, with their PRICELINK product, positively encourage the subscriber to ' . . . . *sign on to INFOSERVICE, set up portfolios and collect data. After you have collected the facts you require, sign off INFOSERVICE, and analyse the data with LOTUS 1-2-3, Symphony or your own custom software.*' This contrasts with the amount of work which went into, for example, the development of the BT HOTLINE full text services, to agree with original owners of text copyrights that material might be held on line even for reading on a terminal. In the case of the scientific and technical database services, those which provide numeric data tend to be fairly specialised, and a typical suite may comprise up to five databases compared with the tens or hundreds found on the bibliographic services ((4), by approximate analysis of the vendor index), so that an access subscription may be an adequate base for the pricing and application licence structure. The LINK Report 1986 (1) concludes in its review of pricing of data services, that the closer relationship between end user and provider, more or less eliminating intermediaries, acts to increase the pressure on the database vendor to allow flexibility in eventual use of the data.

The contrast between the fast moving, ephemeral data 'financial data' services, and the stable physical data sources does not appear to affect these matters significantly.

Basic micro computer systems

Handling numeric information on a microcomputer involves at least the use of general purpose software for processing and presentation, and may, for many users, also require specialised packages. If graphics presentation is important, then special purpose software and hardware are likely to be involved, as the graphics capabilities of standard micro computer screens and printers are limited.

The first, and basic step with any numeric data transferred from a host system to a local micro computer is to place it in a structured form. This structure may be expressed by 'labelling' of data elements explicitly, or by representation in a matrix or vector format with implicit mapping parameters to allow programs to recognise the content. Sometimes this transfer is provided by the data vendor, as discussed below for the financial services. In the worst case, the data is delivered as unstructured 'text', and must be edited by the user into a processable format - which is manageable for small volumes and 'one off' applications but becomes tedious for routine, large scale use. Commonly, however, the format in which data is transferred is adequately defined, but different from that required by local software, and an intermediate program is required to bridge from one to the other.

The simple, general purpose system is therefore likely to consist of a substantial micro computer; communications hardware and a suitable software utility; an editing or converter program for each host system to be accessed; and a processing and presentation package which matches the data to be retrieved. Typical low cost, flexible packages for manipulation of tabular data, simple mathematical processing, and low resolution graphics are found in the 'spreadsheet plus screen graphics' categories - 20/20, EXCEL, LOTUS 1-2-3, MULTIPLAN, SUPERCALC, SYMPHONY, among others. With a little more design investment, the micro computer database packages will provide similar facilities for larger data sets, for example, CARDBOX, OMNIS, Q&A, XL Database, and dBase II might be considered. (Final choice may be determined as much by local supply and support, as by the facilities offered by any one particular package.)

Vendors of financial data especially, but also market data sources, have been under user pressure to make down loading and subsequent manipulation easy and flexible, and have responded in a number of ways. I P Sharp Associates incorporate in their INFOSERVICE products communications software for the IBM pc, the PRICELINK data retrieval and local storage package, and a transfer interface to LOTUS 1-2-3 or SYMPHONY. The same proprietary communications software (MICROCOMM) may be used to treat the local micro as a terminal to the I P Sharp timesharing system, and so use mainframe software for large scale data analysis. Similarly the micro based PLOTCOMM program links to the SUPERPLOT business graphics service on timesharing. At this level of integration, the difference between the micro computer as a processor and as a terminal becomes minimal, although at the price of commitment to a single vendor's service for the duration of a session.

CiSi-Wharton Associates, who also offer a range of integrated services, have developed an product called AREMOS which is intended to be functionally identical on IBM pc XT or AT micro computers under the PC/DOS operating system, and on IBM mainframe systems under VM/CMS - a substantial difference of processor scale. The pc version may be run independently, or switched to the Online Option to download data from Wharton Econometrics databanks, or may be used simply as a terminal to other software on the mainframe, notably for preparation of graphics presentations. Once more, gateways to LOTUS 1-2-3 and other spreadsheet packages are incorporated.

The prices of software in this group, for micro computer versions, tend to fall in the range of $50 to $2,500 for each functional module. Where equivalent software exists for mainframes, it is typically ten to fifteen times more costly, but normally has multi-user capability. (Users of the micro computer versions of ASSASSIN, CAIRS, SEARCH and STATUS will note the similar pattern of pricing, as well as the parallel success in transferring mainframe or minicomputer functionality to the micros.)

Most work on integration of the sort described above seems to have been done for financial and economic data systems, partly because of the large market available for the services, and partly from the 'standard runs on changing data' typical of this application area. In scientific and technical data applications, which tend to be more 'one off' and to be retrievals of stable databases, there is less scope for standard linkages, and the local adaptation of data is common.

It would have been pleasant to be able to cite actual applications by users of both financial and technical numeric sources, using these general purpose micro computer systems. Unfortunately, several users who were prepared to comment informally, had serious reservations about any detail being *published*, basically on the grounds that the applications were central to their business or research, and could not therefore be disclosed. This is, in itself, an interesting comment on the value of numeric data sources, and contrasts with the attitude of bibliographic source users, who are generally willing to publish information about their applications.

Extension of micro computer systems

Requirements depart from the central 'tables and simple graphs' model in two ways - by bringing in graphic presentation in more complex or more exact formats; and by requiring skilled interpretation or management of the data as part of the retrieval process. These extensions may overlap.

So-called 'business graphics' are usually roughly scaled representations of tabular data (8). The typical visual display terminal has a resolution of 30 to 35 points per centimetre (p/cm) which just about allows the human eye to discriminate roman from sans serif text in nine point size text. At this scale, bar charts are fairly well represented, but diagonal lines and curves suffer varying degree of dislocation depending on slope and the details of the screen refresh cycle in use on the particular terminal. Figures 1 and 2 are examples taken from the Macintosh screen by matrix printing, and cutting and pasting of the image into this document. The contrast between the screen quality resolution (at about 30 p/cm), and the surrounding text (about 120 p/cm from a laser printer) is evident.

Such representations, and their equivalents when output on matrix printers are perfectly adequate for adding emphasis or elucidating tabular data, and even for showing topologically based forms such as structural formulæ of chemical compounds or computer circuitry, but are not good for representing precise forms such as spectra, scale drawings, topographic maps and sections, or printed circuit boards. Sometimes a rough representation on screen, supported by a finer print at 120 p/cm on a laser printer is sufficient. If, however, on screen precision matters - as when many sets of data must be rapidly compared - then higher resolution display terminals are required, and within the normal micro computer terminal range, resolutions of up to 40 p/cm are available (in colour, which is now close to the quality of monochrome) at prices of about $2,500 per monitor. The quality of representation on these screens is better than might be expected from the raw resolution, as techniques such as variation of intensity levels may be used to 'round off' the individual picture elements in a way acceptable to human vision. High resolution screens range up to 90 p/cm - but the cost becomes so high as to restrict these devices to CAD and similar applications, and the alternative of printing or plotting of finer versions of rougher displays on screen is common.

Printers range from 70 p/cm for a good matrix device, through 120 p/cm for a small laser printer (such as the printer used for this text) to 900 p/cm for a high quality photo-typesetter.

The main suppliers of graphics quality terminals for data retrieval are Hewlett Packard and Tektronix, and both also provide special purpose plotting software. There are also emulation packages to make other terminals behave (at least logically) like Tektronix units (2). At an intermediate level, the IBM pc with 'enhanced graphics adapter' may use a number of packages such as GEM GRAPH, Microsoft CHART, Harvard PRESENTATION GRAPHICS, STATGRAPHICS and many others, all with differing strengths and selling points, but mostly in the $250-500 range. Similar packages are available for the increasingly important Macintosh range of micro computers.

Subject specialisation, which occurs to a limited extent among the users of financial and economic data sources, is normal for the scientific, technical and medical fields. Because the scientific and technical system hosts tend to carry fewer databases, and because retrieval languages are often subject adapted, the searcher over a range of numeric sources must be aware of more access languages than the bibliographic intermediary. More seriously, unless the searcher is *au fait* with the subject matter being searched, the likelihood of a satisfactory result is small.

	A	B	C	D
1	Country	1984	1985	1986
2	Belgium	22.50	10.30	29.60
3	France	18.00	9.80	3.70
4	Holland	14.90	11.20	17.00
5	Germany	22.80	6.90	18.70
6	Italy	11.40	21.70	15.10
7	UK	16.40	16.60	16.30

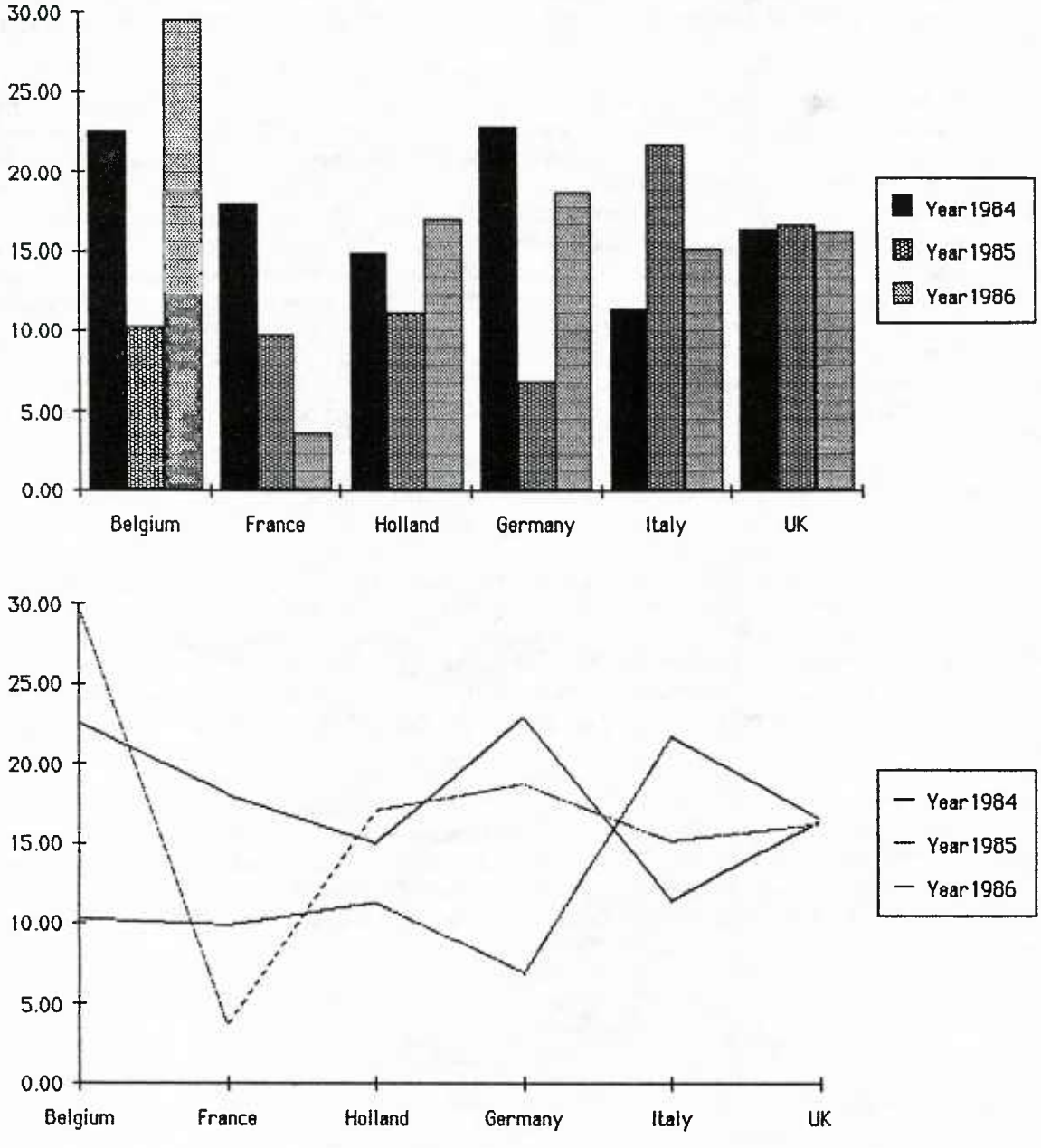
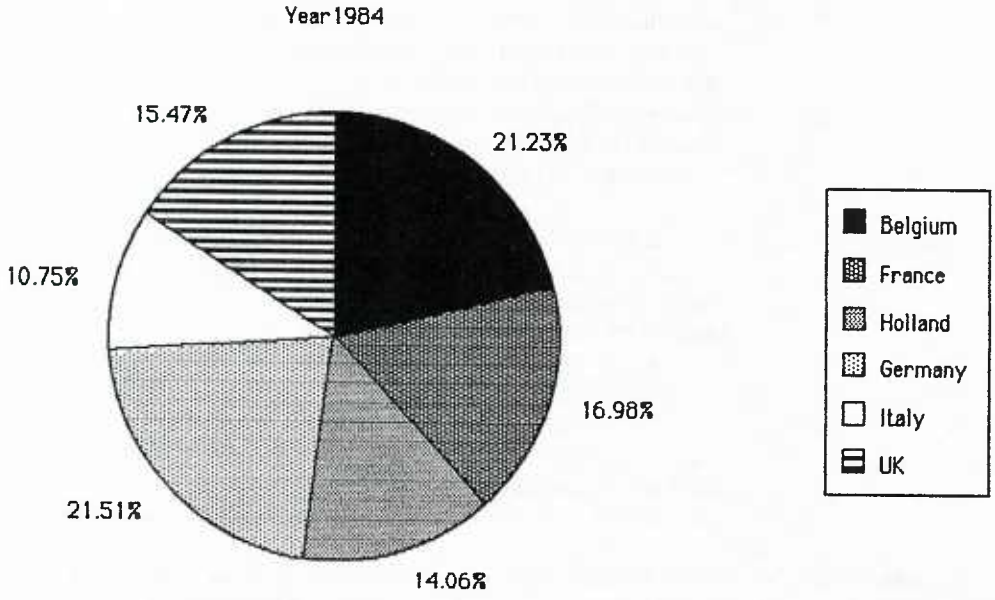


Figure 1 Graph as presented on video screen



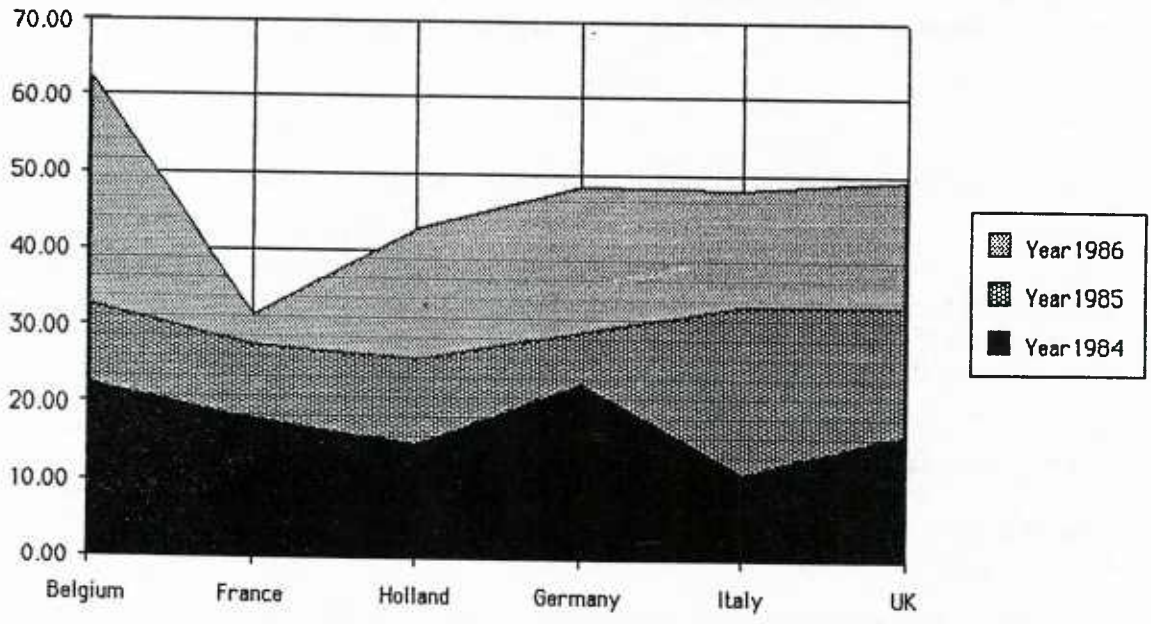


Figure 2 Some pretty, but pointless, versions of Figure 1. See also Tufte (8).

Typical applications cited by Meschel (2) include :

Physical sciences	structure elucidation identification of unknown substances locating spectra of known compounds determination of pollutants in air and water analyses of mixtures by spectra mixing retrieval of fundamental properties of matter calculations on mathematical models
Geophysical sciences	crystallographic structure determinations mixture analysis from X-Ray diffraction spectra retrieval of cartographic data normative analysis of igneous rocks retrieval of weather and climatic data stream run off prediction
Biological & medical	structure retrieval of pharmacologically active molecules epidemiological data analysis retrieval of taxonomic data and location of type specimens

. . . . and this list could probably be extended indefinitely! This diversity inevitably tends to bring the skilled end user into direct contact with the data source, leaving the librarian or information officer to act as a communications and software advisor rather than an information provider.

An area which does not yet appear to have developed on any scale is the application of survey analysis software on micro computers to subsets of census or other survey databases held on mainframes. In particular the SIR and SPSS packages now run on IBM pc AT equipment in versions very close to their IBM mainframe equivalents. (SIR is a relational database system with features adapted to survey data, and simple tabulation and post-processing utilities. SPSS is a highly developed analysis package, with many features, but a very simple data management basis. Fortunately, the two run well together!) Survey packages are applicable to the handling of quite diverse data sets, such as the tabulation of frequencies of the fields of bibliographic records from large collections, and analysis of the users of on line services by their demand patterns.

Conclusions

Online numeric databases are a large and growing information resource.

The major sector, financial and economic information, requires only fairly simple micro computer equipment to make effective use of the services, and data vendors supply suitable package software as part of their product line. Scientific and technical sources tend to need not only special hardware and software to process and present data, but but also subject skills in selection and evaluation. The software is, in some cases, available as micro computer versions of established minicomputer and mainframe packages.

All sources of numeric data tend to be directed to the end user, and the role of the librarian or other intermediary is uncertain, except in institutions on such a scale as to be able to afford information staff qualified in the relevant disciplines. At the same time, the vendors appear to expect the users to down load, process and reapply their data, in contrast to the copyright problems currently associated with bibliographic and full text 'factual' data sources.

This area of information retrieval, management and application is little reported in the library science literature, and may. with the spread of both micro computers and computer competence among the scientific and medical community, come to bypass the conventional library and information services more or less entirely.

References

1 *The European electronic information industry, 1986-1990 : a special report.* Link Resources Corporation, 2, Bath Road, London, W4 1LN, 1986

2 S V Meschel. Numeric databases in the sciences. Online Review, Vol. 8, No. 1, 1984

3 D W King. The future of scientific & technical communication : a perspective from the US. (in) Proceedings of the 9th Online Information Meeting, London, 3-5 December 1985. Learned Information, Oxford and New Jersey, 1985.

4 *Directory of online databases.* Cuadra/Elsevier, New York (This is a quasi-series whose exact bibliographic description is beyond the skills of the present author!)

5 *Computer readable databases.* (ed) M E Williams et al. North Holland, Amsterdam, New York and Oxford (Annual)

6 A Foster and G Smith. *Online business sourcebook.* Headland Press, London, 1986

7 V E Hampel. Fact retrieval in the 1980's. (in) *What should users expect from information storage and retrieval systems of the 1980's?* AGARD Conference Proceedings No. 304, Munich 1981. AGARD, Neuilly-sur-Seine, 1978

8 E R Tufte. *The visual display of quantitative information.* Graphics Press, Ct., 1983

(This may well be the best book ever written on the subject - if you read nothing else about graphics, read this!)

KNOWLEDGE BASED SYSTEMS IN INFORMATION WORK

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Introduction

The theme of this paper is the impact of artificial intelligence on the use of computer based systems in information work. The background to A.I. will be briefly discussed, followed by examples of some of the possible applications. Particular consideration will be given to the system developed at Harwell which provides corrosion information (ACHILLES).

Artificial Intelligence

This area of activity has been concerned with many aspects of the application of computers. We are mainly concerned here with the area known as "expert systems" or better "knowledge based systems". These systems provide a means of representing human knowledge in some high level form and using this knowledge to aid human beings in "problem solving".

AI has also contributed to developments in the use of natural language interfaces to computer systems. Much of the A.I. research in this area seems orientated to machine translation. Systems have been developed to process text in order to provide a precis or to identify the subject matter of a piece of text.

Knowledge Based Systems

These are systems which provide two major features. First, a means of representing knowledge, ideally in some form which is comprehensible to the domain expert(s) who will build and maintain the system. The second feature is a "processor" which enables the user to access and manipulate the knowledge base in order to help him solve his problem. In most expert system development tools ("shells") the form of knowledge representation is the "rule". This takes the form:-

IF "some facts" are TRUE then "carry out some actions"

Examples will make clear how this simple form of knowledge representation works.

```
IF   SALARY LESS THAN £1000   THEN   TELL USER "NO TAX DUE"

IF   STEAM PRESSURE HIGH
     AND SPEED HIGH           THEN   REDUCE FUEL INPUT

IF   CLOUDS ARE DARK AND
     PRESSURE IS FALLING      THEN   EXPECT RAIN

IF   METAL IS STAINLESS STEEL
     AND CHLORIDE PRESENT
     AND TEMPERATURE > 80 °C
                              THEN   ADVISE USER STRESS CORROSION
                                     CRACKING IS VERY LIKELY
```

The shell has also got to provide a means whereby the developer can provide a user interface which will allow for input in response to questions and output as a result of the triggering of rules. Most commercial shells talk about producing "user friendly" interfaces, though few in fact achieve this aim. This is one of the most difficult parts of a knowledge based system to develop.

Other forms of knowledge representation, including frames and semantic networks, are sometimes used. For the purposes of this paper they provide the same type of system as do rule based representations. They may be more or less effective depending on the particular subject area of the system.

Knowledge based systems provide a means whereby experts can share their expertise with each other and with the less expert. They may provide direct answers from stand alone expert systems or they may provide "intelligent" front ends to existing information systems. The main impact on information systems work is likely to be in the latter area and discussion of this will cover most of the problems and strengths of stand alone systems. The remainder of this paper will use one particular system as a framework for this discussion.

Information Retrieval

In the most general situation information retrieval is concerned with "finding" facts which will solve some user "problem". There are implicit in this process many kinds of expertise. Thus to use a retrieval system one needs to know about

How to get onto the computer system
(may involve use of networks etc.)

How to access a particular "database"

The command language for the system and database

Various aspects of the database structure and its scope

The query language

The subject domain

The procedure then is to place a knowledge based system between the "user" and the database.

Characteristically knowledge based systems deal with narrow subject areas. In most practical situations there will need to be a hierarchy of knowledge based systems between the user and the database. Even at the subject level, there will be an initial system which helps to determine which particular system is required.

For some problems the user may never explicitly "see" the database, though the KBS that he is using has accessed it.

ACHILLES

Over the last four years, Harwell in conjunction with the National Corrosion Coordination Centre (National Physical Laboratory) has developed the system called ACHILLES.

This system is designed to provide knowledge based systems in the field of metal corrosion with access to papers and other documents. The latter are important as they provide the evidence on which the experts opinions are based, and the database also provides part of the methodology for building the knowledge based systems and ensuring as far as possible that they are accurate and consistent.

The software used consists of three main components. The database uses 'STATUS', an information retrieval system developed at Harwell and marketed worldwide. This provides free text and structured retrieval capabilities with a very flexible user interface. The KB systems are developed using a rule based system called SPICES, also developed at Harwell, written in PROLOG, but providing access to routines etc. in any other programming language. Graphics are also included so that communication with the user may be through text, graphs or diagrams.

The rule based components of the total system are developed by the corrosion experts. Very little initial training in the use of SPICES etc. has proved necessary.

Characteristics of ACHILLES

The user with a problem in the field of corrosion could approach an expert or try to find the information in the literature by himself. In the latter case he would face all the problems mentioned earlier. The use of ACHILLES first of all helps him to formulate his problem in terms consistent with the language of the database, and may then give him an answer to his problem. If he is concerned to see further details, or needs to see justification then he may directly access the database. This contains original papers, special articles on particular aspects of corrosion and manufacturers brochures on for example coating products. The knowledge base represents a considered view of the database material. Indeed the experts involved in building the system find the "rule based" style helps them communicate with one another in a formal way.

Most retrieval systems provide a considerable number of user commands, and some, like STATUS, provide the ability to produce commands orientated to the particular application. Many of the problems faced by a user stem from the complexity of commands. In ACHILLES the basic set of commands is reduced to five. The system can be used with no training beyond that required to use a keyboard. Since the level of expertise of the users will vary considerably, the user interface has to contain many different levels of 'help' and amplification of questions or messages. Any particular user will then feel that the system is functioning at the right level for his degree of expertise.

Other Information Applications

The use of knowledge based systems to provide front ends to other applications is increasing.

Systems to improve the quality of cataloguing have been developed.

Natural language interfaces to all types of database have been developed. Some of these are direct 'question interpreters', others attempt to use context to advise and help the searcher.

Knowledge based systems for computer network control and access are in use.

In most cases the impetus for the use of knowledge based techniques rather than conventional coding comes from the ease with which systems can be developed and modified using rule based or related techniques.

Microcomputers in Information Resource Sharing: 2 Full Text Systems.

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Summary

Full text database use in Europe has been slow to develop, due in part to the narrow definition commonly adopted. In its widest sense, full text may be used to comprise all databases, textual or numeric, which are complete in themselves and do not merely refer the user onward to the primary literature. A range of factors - market structure, language, economics, copyright and others - influences the emergence of full text services in Europe, and the effect of these factors is often quite different from that on the bibliographic market, and indeed on North American full text developments.

Technological changes in computers, storage technology and software, both within and outside the 'online industry' affect the use of full text sources. In particular, since full text tends to emphasize the importance of decentralised information services, innovations in CD-ROM and magnetic media deserve consideration as they ease the creation of practical selections from large text sources for particular users, and also create opportunities and so influence the scope of data available in full text mode.

In the science, technology and medicine field [STM], a wide range of full text information is already available and is expanding steadily. Most online services are directed at end users, and many assume that the user's access terminal will be a microcomputer capable of further processing - a trend which has implications for librarians and others involved in providing information services.

Introduction

Online database use has a relatively short history - both in Europe and North America. The first publicly available systems came online in 1972, since when the technology has made made massive strides forward, both in the nature of the databases available and the manner in which these files are handled and presented. Online began as an essentially passive service, making bibliographic information available primarily to the library community. What was being provided was not really an end-product in its own right, but access to the primary literature of science and technology. As such, the early objectives of online systems were simple, and did not differ radically from the batch services which had been available for three or four years save, that is, in the range and scope of the files which very quickly became available.

Early online services not only concentrated on bibliographic data but on the scientific and technical fields. This was probably inevitable. The STM [science, technology, medicine] areas have a well developed and long history of secondary publication use. Link this to the fact that much of the early drive to online use came from the US medical and aeronautics industries, and the emphasis of the early Lockheed and SDC files is largely explained. In the early 1970s, is is probably also fair to say, that outside the fields of science and technolo

the potential of online was poorly recognised. This accounts for why many in the business and commercial areas did not seek online access, and indeed, why many of the database producers first involved did not look to expand their services outside the purely STM field.

If the earliest participants in the database industry were slow to recognise the massive potential of other areas, the same cannot be said of all publishers. Throughout the late 1970s, and into the early 1980s, database files aimed at business, finance and commerce have become the fastest growing sector of the online industry. Indeed so dominant have these files become, that a 1986 Link report estimates that they now account for between 80 and 90% of all online revenues in Western Europe - a percentage which still appears to be rising [1]. While such files have changed the subject base of online information, they have also had a profound affect on the nature of the services themselves. It is now common to talk about the online industry as comprising three sectors; bibliographic information, numeric data and full text services. Though this is something of an oversimplification, and a division which technical change has already eroded, it does provide a useful starting point. It also enables us to define precisely what we mean by full text in the terms of this paper.

It has become common practice to use full text to mean purely textual files - services like Mead's LEXIS or Datasolve's World Reporter. This gives problems when we consider files like Inspec's EMIS service, Martindale or Harwell's Chemdata. These are not files which are textual in the style of Mead's LEXIS, though they are files which are free standing and entire in themselves. Like LEXIS, such files are typically looking to provide all information, not onward access to a library collection. We hear a great deal of talk about 'one stop shopping'. Usually this is used in association with the range of databases held within one online host. This is an important marketing factor. Users we know do not like to switch hosts to gain access to a range of database files, a fact which tends to see the market drift inevitably towards the larger hosts. But 'one stop shopping' has a wider meaning. It can also be taken to mean gaining access to the full information in online mode - with no need for the onward collection of references and cutting. Such a trend has massive implications not just for the online industry - but also for the library and information communities.

Full text information, no matter how broadly we define it, presents particular problems. In this meeting we will examine full text services in two papers. I will cover the services which are available, and some of the problems they present both for the user and the service provider. I will also look briefly at some of the subset developments in magnetic media and CD-ROM, which could yet interact with the full text market. In a separate paper John Ashford will examine the link between microcomputers, full text and numeric data, and above all examine the derived facilities which become possible as a result of any wide expansion in the provision of full text. Although the main emphasis of these papers will be science and technology, given the current structure of the full text market, some drift into other areas is inevitable. I would also prefer largely to ignore the accepted division between numeric and full text databases - and concentrate on all non-bibliographic sources. In this we will cut across some currently accepted divisions, to talk about both databases and online journals. These are anyway divisions which many believe to be part of the development phase of full text information, and not of long-term significance.

The marketplace for full text.

That full text services in Europe and North America have not emerged more quickly deserves explanation. In the early stages of online, cost:storage ratios did much to inhibit the expansion of full text. To hold large blocks of information available for online interrogation was clearly expensive, a concept outside the reach of all but the Mead Data Centrals of this world. It is also true that most users were accessing online services via very basic terminals, terminals in which intelligence and local storage was limited or non-existent. This made it inevitable that the service providers should go only part of the way, and supply services which were secondary in nature providing onward access to primary information. If such essentially technical constraints were understandable in the early and mid 1970s, they do not account for why full text still struggles to gain acceptance. Computer storage costs have dropped, database management software has improved out of recognition, and we know that many - if not most - users are now accessing hosts via very sophisticated terminals incorporating significant local storage and intelligence. In this respect, full text is not unlike many other areas of electronic publishing, where it is not the technology, but financial, economic, social and market issues which now largely determine its rate of progress.

In Europe, one factor which clearly inhibits the progress of full text is the nature of the market. Although Europe has areas where online use is well developed, there is a lower use of online generally in the region. This relates in part to hardware availability and attitude, but also to the fact that in many subject areas, there is still an acute shortage of databases of high European relevance. This applies despite the massive expansion in database files over the last five years, so ably recorded by Carlos Cuadra - and others. In terms of full text, the national and linguistic fragmentation of the European region presents particular problems. Despite reductions in computer storage costs, full text is still a very expensive medium. Where services like LEXIS can look to recover their development and running costs on a market with a base population of some 250 million - plus some add-on sales in Europe - this is not possible outside North America. In Western Europe, not only is the largest potential national market smaller [West Germany at just over 60 million], but the complex issue of language also intrudes. This serves to fragment the market, and has led many to believe that, given the current state of the art of computer hardware and storage, it would be virtually impossible for a service like LEXIS to become truly viable in Europe.

While the structure of the market does not facilitate the introduction of large-scale full text files in Europe, the same could also be said of the nature of the European publishing industry. With relatively few exceptions, publishing in Europe is based on small, national companies who lack the type of investment needed to become involved in the provision of large-scale, full text services. This would seem to suggest that the European full-text industry will emerge more modestly than that seen in the US, with companies looking to develop products where the use of full-text offers very clear advantages. This has to some extent already been seen in the numeric database field, where the services provided by companies like Telerate and Reuters, offer a depth not possible by more conventional means. These companies also have a totally different approach to information, when compared with other more conventional online areas. In the numeric field information is regarded very much as a transient commodity, in which today's requirements are soon displaced by a new set of information needs. This clearly

available. The demand for good databases is not just sustained, it is burgeoning. The industry participant who now looks most at risk is the online host, and there is no doubt that Europe is significantly over-supplied with hosts - most of whom continue to function only because they are heavily subsidised.

The role of CD-ROM

In the last two years most emphasis on subset products has concentrated on the potential of CD-ROM. This is unfortunate, not least because it largely ignores some of the major developments in magnetic media. Among the first subset products to be made available on floppy disks were the BIOSIS BITS files. These provide bibliographic data in the biological field. Of more interest to our consideration of full text, is Chemdata - Harwell's file covering some 30,000 hazardous chemicals. This file turns round the traditional concept of an online database subsequently offering subset data, because it was conceived as a free standing micro based product which was only later made available in online mode. Above all, Chemdata shows what can be achieved with magnetic media - and a little ingenuity. It can be broken down and used on floppy disks, though the full file is normally loaded on a 10 megabyte hard disc. It uses dBASEII software, and can run on any micro with a Z80 microprocessor that will support CP/M and has 48K of user memory. I will come back to Chemdata later in this paper when I consider the type of information coming through in full text form. Here it serves to emphasise that we should not be too ready to discount the use of magnetic media, whatever the potential CD-ROM appears to offer.

So far those products coming through using CD-ROM are limited, and make no attempt to use the discs full capacity. This is not surprising given that the full potential of a CD-ROM disc is some 600 Mb - or around 200,000 A4 pages - or some 1,000 floppy disks. This is clearly massive, and it is evident that we should stop talking about CD-ROM as a computer storage medium, and begin to recognise that it is in fact a new, and very demanding publishing medium. Indeed many analysts now believe CD-ROM is the most demanding electronic publishing medium yet conceived, a medium in fact which will demand a totally new conceptualisation in the products which come through to the marketplace. In the long-term it could, and indeed almost certainly will, make a new generation of decentralised bibliographic and full text products possible. These will certainly interact with the full text online market. We are currently at least three years - or more - away from this happening, though some of the products coming through are interesting, and do serve at least to indicate the disc's potential.

For the reasons given, much of the early emphasis on CD-ROM has been shown by the established secondary publishers. Already a number of subsets of conventional databases, are available on CD-ROM. These typically cost between US $1,150 and US $1,195 - for an annual subscription comprising four quarterly updates. Though interesting such charging levels should be regarded with caution. They relate to a very new and speculative product. As such they are more likely to be based on market development and analysis, than a truly costed commercial basis. Certainly the products which finally reach the marketplace could well be costed differently. The subsets currently available use DEC discs, Battelle MicroBASIS software, and include:

Chemical Abstracts: Health and Safety in Chemistry;
NTIS: Computer, Communication and Electronics;
NTIS: Environmental Health and Safety;
Compendex: Aerospace Engineering.

These are, it should be emphasised, bibliographic files. So far no-one, certainly in Western Europe, has marketed a full text product using CD-ROM technology.

CD-ROM is currently being evaluated for a wide range of other products. Many of these involve full text or statistical data, while many also involve company information like law guides, maintenance manuals, training and product manuals. One area where CD-ROM may yet have major implications is in patent information. With their close mix of textual and diagrammatic data, patents present particular problems for conventional online services. We have seen the emergence of clever but rather contrived products like Videopatsearch, which use a parallel online and videodisk facility to provide both text and graphics. This type of essentially compromise technology, could become unnecessary if CD-ROM fulfills its full potential. Not surprising abstract publishers active in the patent field are know to be closely reviewing CD-ROM, as too are Pergamon Infoline the UK host with a particular interest in the patent field.

How quickly CD-ROM may become a force in the electronic full text field is far from clear. It is also uncertain how this technology will interact with the online provision of full text. One thing is certain, and that is that the technology does have major advantages over other optical media whose use has been reviewed and largely discarded over recent years. It also has a close and synergic link with a fast growing consumer market in compact audio discs. This gives the technology a secure appearance, largely lacking in other optical media. Those involved have also very quickly recognised the importance of standards, and the first CD-ROM standards emerged during 1985. Given the massive storage capacities involved, it is not surprising that early standards have concentrated on determining how files can be located on a disc, and what directory access structures are required. These problems, plus the massive software implications the technology poses, must be resolved before we can begin to assess the potential of CD-ROM for delivering full text information.

Full text information - some cases

So far this paper has concentrated on the background to the West European full text market, and the factors which influence full text availability in the region. It must also consider the type of information currently available in full text mode, and indeed the type of information it is reasonable to expect in the future. In this context I would prefer to use our wider definition of full text, to include those files entire in themselves, rather than the more conventional definition which concentrates on files which are large - and essentially textual. This means the inclusion of databases like Martindale and Chemdata, which may not contain lengthy information, but are certainly complete in themselves. We must recognise in this respect, that files need not be massive to be definitive, and that full text must be concerned with accuracy, quality - and the relevance of the information to the end-user - not just its length and volume.

The conventional assessment of the full text sector performed by Link earlier this year, estimated the total West European market at around US $15 million. This clearly uses our more restricted definition of full text. It therefore separates out numeric and bibliographic databases, with the bulk of the revenues being made up by Mead's LEXIS and Datasolve's World Reporter. While

this assessment is fine, if we accept the narrow, traditional definition of full text, it clearly does not take into account the mass of small textual and data files which are really used in full text mode. These include such products as the IRCS Medical Journals, Britoil's MESC [Engineering Supplies and Materials], Martindale, Inspec's EMIS [Electronic Materials Information Service] - and many more. It is also questionable whether any wider definition of full text should not also include services like Finsbury Data's Textline. While this essentially represents abstract information, the abstracts are long, detailed and informative, designed in many cases to stand in place of the original. What we seeing really is a situation where changes in technology and service provision, are making some of the traditional and long accepted categories of online information very difficult to sustain.

It is clearly not possible to review here all the files currently available in full text form. What I have done is to select some of those which illustrate the use of full text information, and above all those which exploit the benefits online offers over more conventional forms of information retrieval. Among the areas best served for full text information is undoubtedly the pharmacuetical field. At a numeric level most major drug companies in the UK make heavy use of the IMS audit data in online mode, while at a technical level Martindale gives pharmacopoeia information on most drugs in therapeutic use. If this were not enough, later this year Data Star are scheduled to launch in full text form the three Scrip files [Scrip, Clinica and Animal Farm]. These constitute the most important, and well respected, market newsletters in the pharmaceuticals field. If this were not enough, the whole area is now underpinned by the drug information contained in the various sectors of Elsevier's IRCS Medical Service.

In many ways Martindale Online is a perfect example of a product suited to full text availability. It is based upon a long established print product, and uses online to develop services which, if possible in hard copy form, are certainly far more difficult. Martindale covers some 5,000 drugs and medicines, as well as fringe products like colouring agents, insecticides, preservatives and noxious substances - like asbestos. Among the details included by Martindale are nomenclature, physical and pharmacological properties, adverse effects, contra-indications, use and dosage levels. In online form Martindale offers the user six main approaches to the information it contains. These comprise:

Chapter Introduction Record:
essentially a very general and background approach to the product under consideration;

Drug Definition and Description Record:
A more detailed record covering the drug name [and synonyms] together with its molecular formula and any physical criteria which relate to its use;

Action and Use Text Record:
Textual information on the pharmacological properties and use of the drug. This section is widely cross-referenced to drugs or other substances exhibiting similar properties;

Action and Use Abstract:
Similar information to the Action and Use Text Record but provided in abstract form and essentially in bibliogrpahic mode.

Preparations Record:
Details of the preparations, and precautions needed for the products during clinical use.

Proprietary Preparations Record:
Name of product, manufacturer, different presentations - and areas of use. The Proprietary Preparations Record also gives details of the countries in which the product is sold -and under what name.

The essential feature of Martindale Online, and indeed all better full text files, is their practical and pragmatic approach. Here information is very closely tailored to the requirements of the end-user. This inevitably makes the database demanding in technical terms, and indeed the conditions of use of Martindale Online include the statement that the file is created with the assumption that the user has the necessary training to interpret the information it contains. This has implications for the library and information professions, and more and more we are seeing the creation of full text files designed specifically for end-user use. Martindale Online is currently available in Europe via Data Star, though the file is also soon to be made available via Dialog.

Although Martindale provides access to bibliographic material, and indeed the whole database is created from referenced journal articles, data sheets, reports and standard publications, its main attraction in online mode is the access it provides to hard factual data. Outside Martindale, and the pharmaceuticals field, the general medical area is also becoming increasingly well served by other full text services. The IRCS Medical Science Database contains the full text of medical research papers indexed under 32 medical or biomedical headings. Each paper is around 1000 words in length and contains details of methodology, research background and results. Essentially journals like IRCS, and CNOL [Clinical Notes Online], provide a fast alerting function, not all that different from the early letters journals. As such they perform an important role and not just in medicine. Also of growing importance in the medical online area, are text directories like John Wiley's Medical Research Directory [MRDW]. MRDW covers 650 medical research institutions in the UK, giving a subject breakdown of biomedical research in progress in universities, polytechnics, government laboratories and other research establishments.

The medical field tends to emphasise more than any other the close link between, what might be defined as databases, and online full text journals. Thus Martindale is a central database, compiled and evaluated from a range of sources, while CNOL is really an online full text journal. In this respect, full text online is mirroring a pattern seen in the hard copy field, where we have primary material produced in edited but non-evaluated form plus tertiary and definitive material which is normally based on a wide range of assessed sources - and can be regarded as definitive. Pure online journals have grown very rapidly in the medical field. BRS Colleague now has nearly 40 full text journals online, around half of them in the medical field. All are complete full text versions of the hard copy, and are typically issued several days ahead of the hard copy. Current medical journals now available in full text mode through BRS Colleague include:

'The British Medical Journal;
Lancet;
British Heart Journal;
Thorax;
Journal Clinical Pathology;

Age and Ageing;
Quarterly Journal of Medicine;
Gut;
Prenatal Diagnosis;
British Journal of Rheumatology;
British Journal of Diseases of the Chest.

- and many more.

Outside pure medical science, the health and safety field has become an active area for the use of full text files. Chemdata, produced by Harwell's National Chemical Emergency Centre, was originally conceived as a free standing micro-based product since when it has been made available in online mode through both EXIS and Data Centralen. Chemdata is a database in the strictest sense of the word, with the information it contains being evaluated and verified by NCEC. It covers some 30,000 hazardous chemicals and is primarily concerned with giving information on the risks they pose during transportation, and how major spillages should be handled and contained. To this end the database has a number of specialist fields including:

* information of personal protection;
* information on hazards;
* description of physical form;
* information on precautions;
* information related to fire fighting;
* sources of specialist advice;
* advice on decontamination.

The free-standing Chemdata file, was designed primarily for use by fire brigades. It is used by most British fire departments - and also has a number of sales overseas. In online form it provides an important part of the EXIS service, a series of database products primarily concerned with shipping and transportation. Chemdata was designed for use by fire officers inexperienced in using computers - and working under considerable pressure. As such it is very much a product for the end user - not the intermediary. It allows a range of search options including product name, synonyms, trade names, UN substance identifier code and by the Chemdata document reference number. The search software allows a considerable degree of truncation - both left and right - the philosophy being that in a spillage situation part of the container may be destroyed - and any information is better than none.

Chemdata does serve to illustrate one feature of some full text files. Where bibliographic databases are concerned with providing non-evaluated listings and abstracts, this is far less acceptable in many full text areas. Clearly with a file like Chemdata, the quality of the information retrieved, has a direct relationship to the skill and the depth of understanding of the staff creating the file. This type of evaluated database, is more demanding to compile both in staff time - and in the level of the staff used. This makes such files far more expensive to construct - and to use - than conventional bibliogrpahic services, or indeed full text services which are merely putting large blocks of information online. This serves to limit applications. While it is easy to see areas where evaluated full text services would be useful, the costs of constructing the file, and the end-user charges involved, can prove prohibitive.

Not surprisingly most evaluated full text files like Chemdata are created by government agencies, or developed and made available in heavily subsidised form. One of the earliest to be attempted by a commercial secondary publisher is Inspec's EMIS file. This is a purely online file, with no hard copy

equivalent. It provides hard data on the properties of a range of materials used in solid state electronics. EMIS is a very difficult product to categorise - a fact which has led some analysts to refer to it as a hybrid database. It provides a mix of hard physical data, some bibliographic information and directory information on the availability of materials from a range of suppliers. It also offers a publishing facility giving those involved in research a rapid and effective means of disseminating their results.

EMIS is an ambitious product and was reported to be struggling soon after its initial launch. Most of the problems it seems came, not from any deficiency in the product, but from an absence of hardware in the marketplace to exploit its use. This is significant. We tend to assume that most areas now have micros, or at least access to terminals and modems. Although this may be true where we are looking to sell to intermediaries or the library environment, it may, as EMIS found, be less true when we are looking to sell products to the end-user. In all events, EMIS's initial problems now appear to be over. The file which began only on the Geisco network, is now also available through ESA/IRS, a fact which should significantly widen its user base.

Implications for information specialists

This paper is primarily about full text, the background to the market, and the factors which influence its development. It has examined these factors most particularly as they apply to Western Europe. Indeed one of the main areas of emphasis of this paper must be the essentially different nature of the US and West European full text markets. In any consideration of full text it would be foolish not to recognise the implications the technology has for the conventional library and information professions. Where bibliographic online grew naturally out of the conventional secondary publishing field and so put librarians and information scientists in a core and central position, the same is certainly not true of full text services. Most full text databases are designed for the end-user, and marketed directly to those users. In many cases, as we have seen, these products really only make sense if they are viewed in the context of the end-user.

Many in the library and information community view any expansion in the availability of full text products with considerable concern. This applies whether the product is made available in online mode, or via one of the options which now make possible the design of significant subset products. In the early days of full text, and particularly online journals, much of this concern was expressed via doubts over the likely quality and standing of any material made available in full text form. These doubts now look premature and unnecessary. Experience has shown that the cost factors of online, and full text in particular, largely preclude its use for the dissemination of rubbish. There is no evidence that the wide use of online, now with the increasing absence of hard copy back up, has brought any significant decline in publishing standards. Indeed, the very heavy involvement of end-users in the use of full text services, makes it a very demanding publishing medium, and one in which it would be hard to conceal any drop in standards.

Where full text may see a reduced involvement for librarians and information scientists, this need not prove disastrous. The whole sphere of information is now getting so complex and integrated, that it is inconceivable that the conventional information professions do not have a major role to play. Many

believe that role could be far more demanding and satisfying than anything so far achieved. The complexity of modern information services means that there is a vital need for information professionals, and indeed publishers, who understand the correct balance between the conventional and the electronic - and within the electronic - the correct choice of the technical options available. This applies both in the publishing and dissemination of information - and in its retrieval. It is exactly this type of function which modern librarians and information scientists have the qualifications, background and experience to perform.

Perhaps one cautionary note appears necessary here. From their earliest training librarians, particularly from the academic and the public sectors, are discouraged from evaluating the information their holdings contain. This is unfortunate. The future looks far less certain for those involved in the purely passive functions like collecting, organising, storing and disseminating information. Evaluation could well provide the key to the information professions of tomorrow. We now have the ability to collect, organise and disseminate mass information in electronic form. At the end of the day, the most important role of all may yet fall to those who can find their way through this mass of information, and assess and evaluate the content of what is finally provided To this end we must recognise that what is vital is not just access to information - but the quality and standing of the information we have accessed.

1. The European Electronic Information Industry 1986-1990 - a special report. London. Link Resources Corporation July 1986.

Trends in software & system development

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Summary

The developments in microcomputers now being applied in information work have, in the majority of cases, been 'adopted' from innovations directed at very much larger markets. Present trends are to reduced real costs of both software and equipment, which is helpful in making existing systems cheaper, but not necessarily good for new library oriented developments. The need for fact retrieval is becoming more important, and developments in electronic publishing and document exchange will be important. The integration of text, graphics and images is improving, depending partly on new software ideas, and partly on the availability of optical disc storage for large volumes of data. Text retrieval is becoming a feature of some relational database systems, offering an alternative to inverse file approaches, and the use of signature representations may lead both to simple small scale retrievers, and to methods of identifying duplicate records in archives.

The development environment

Scientific and technical information work, important as it is to those engaged in providing services and to their users, represents only a small portion of the many applications which have been developed in the last few years to take advantage of the increasing power and versatility of the micro computer. In consequence, in any account of development trends, it is necessary to distinguish those which will affect the majority of micro computer users - and from which information specialists may be expected to benefit without special investment - from those which have information management in some form as their particular objective, and so will offer more closely adapted services to a smaller group of users.

In the following account, those aspects of information work concerned with office services, financial planning and performance analysis, use of electronic mail and other message handling services and recording of items of equipment and furniture are regarded as potentially useful time savers, but essentially indistinguishable from small scale administration in general. On the other hand, information storage and retrieval, mainly of text or hybrid forms, library processes such as ordering and accession systems, cataloguing, loan control and stock application statistics are sufficiently specialised to be treated as significantly different from the main stream of general purpose 'package' software (1, 2).

Note the assumption that the majority of software of interest to information specialists will be acquired by 'purchase and adaptation' rather than writing from original designs. The disparity in cost between an established package system for a micro computer, say $1500 for a system as wide in scope as ASSASSIN or STATUS, and an experienced programmer at $20,000 to $50,000 per year depending on the way in which such services are costed in a particular institution, means that it may cost between ten and one thousand times as much to develop new programs as to buy in commercially available and proven software. In the case of widely applicable and general purpose software - word processing, for example - entrepreneurial software companies may choose to bear the initial cost and risk of making a versatile product, in the hope of reaching a large scale market. Promotional budgets in the region of millions of dollars are reported, and the successes become widely used and sometimes almost 'standards' for the next round of innovation to aim to surpass.

Software intended for the information specialist or librarian does not benefit from so large a prospective market place, except perhaps in the case of the on line bureau services such as BRS, DIALOG, Infoline and SDC. Until the arrival of the micro computer, library software products sold in tens (satisfactory for many producers) to a few hundred (exceptional), and prices in the $10,000 to $50,000 range were quite common. In a number of cases, 'package' systems were first implemented as one-off developments, and later generalised. ALS and Derbyshire County Library (3), GEAC and the Universities of Guelph and Waterloo (4), and UREKA and the University of Tasmania (5) are among the better known examples. This trend has continued with micro

computer based packages, for example the Macbeth MMS library system range and the University of Aston, (6), and MIRABILIS at the University of London (7). Among the free text retrieval systems, ASSASSIN, BASIS, CAIRS, DECO, STATUS (8) were originally seen mainly as 'in house' systems which were later marketed. This conversion of local to marketable systems is still going on, but becomes more and more difficult as competition increases, software prices (and price **expectations**) fall, and standards of what is acceptable in user interfaces and documentation become higher and so more costly to implement.

It is likely, therefore, that the next few years will see the majority of innovations of interest to information specialists coming from adaptation of more generally directed developments. The pace of special software development for the particular information application will be much slower, though products which do emerge are likely to be of considerable interest, and some trends are identified in later sections of this paper. A continuing source of micro computer products of some scale and complexity will be the conversion of present minicomputer packages to run on the larger micro computers, especially as the difference between a small minicomputer and a large micro computer continues to narrow.

Development trends : all microcomputer applications

The best established trend for micros is towards more computer for less cost. At the time of writing - early May 1986 - £5,000 in UK buys a Macintosh with one million characters of storage, a ten million character 'hard' disc, matrix printer and an integrated package of word processing, spreadsheet, database, telecommunications and simple graphics software. This price is being attacked by at least one other vendor, and by the end of 1986 it would not be surprising to see systems which are larger or faster or cheaper or all three on sale in North America and Europe. The IBM pc, in its XT and AT versions, which numerically dominate these markets for medium sized 'business micros', already looks a little small and a little slow against competition from similar machines, and IBM has announced the UNIX based pc RT, which appears to be both more versatile and more powerful than its earlier relatives. Among the larger european vendors, Apricot, Ferranti and Olivetti are following a similar path of more or less constant prices but steadily increasing performance. (9)

Now, in the last few years many experimental or small scale library applications have been successfully developed on much smaller micro computers - 128k memory and floppy discs, often - so that size and power have not been absolute constraints (10, 11, 12). What is new, however, is that systems are becoming available on which tasks at practical volumes of data can be assigned to micro computers, and information storage and retrieval not only of numeric and coded data, but also of much more extensive textual matter are realistic. At the same time, larger computer memories allow switching between applications to be more flexible, and offer the possibility of multi-user operating systems when the work loads are not too severe in disc accessing.

Along with the larger micro computer has come the integrated application system. Current examples include Framework, (Ashton-Tate); KMON/2, (MDBS); JAZZ and SYMPHONY, (Lotus Development Corporation); Xchange, (Psion). In JAZZ, for example, the user finds word processing, a spreadsheet for performing a wide range of calculations in 'analysis page' format; a simple database handler with input formatting and report generation; a business graphics facility; and communications. Applications may move freely from one service to another, incorporating spreadsheet data graphics illustrations in text reports, and updating the text of the report dynamically as the data in the spreadsheet is revised. At present, it is usually not too difficult to find individual word processors or spreadsheets or databases which outperform the separate parts of the integrated system, but developers are improving their products rapidly. For the information specialist, the most useful outcome is likely to be the opportunity to design and install quite complex administrative systems without needing to call on professional computing staff - so saving time and cost, and ensuring that the computer does what the user actually wants, rather than what the analyst thought was intended. The interface with the computer must, in these user directed systems, be particularly easy to understand and use, and much development work is being done in this area. One trend - the subject of considerable argument among computer professionals, but generally popular with users - is to offer a pictorial or 'icon' view of current operations. Figure 1 shows part of the current state of the author's 'desk top' while preparing this paper.

Another encouraging development is that of 'electronic books' which allow either informative or training material to be presented in the same context as application software. One example which has been published is the GUIDE system, based on work by Peter Brown at the University of Kent (13), and being implemented commercially by Office Workstations Limited of Edinburgh for the Macintosh and IBM pc series. Such systems allow a technical author to write text at a high level, but including sensitive points such as words in bold

characters, or underlined. When such a sensitive word (or 'button' in Brown's language) is selected, the text is expanded on-line to reveal a lower level of detail, which may itself contain 'button' words. Those words which are underlined expand temporarily into brief definitions, which disappear again as the selection is released. Potential applications - currently mostly experimental - include the instruction manual for GUIDE itself; a handbook on assembling electronic networks; a fault diagnosis guide for maintenance of electromechanical equipment; and plant taxonomies. Diagrams and simple images are included in some of the demonstration cases.

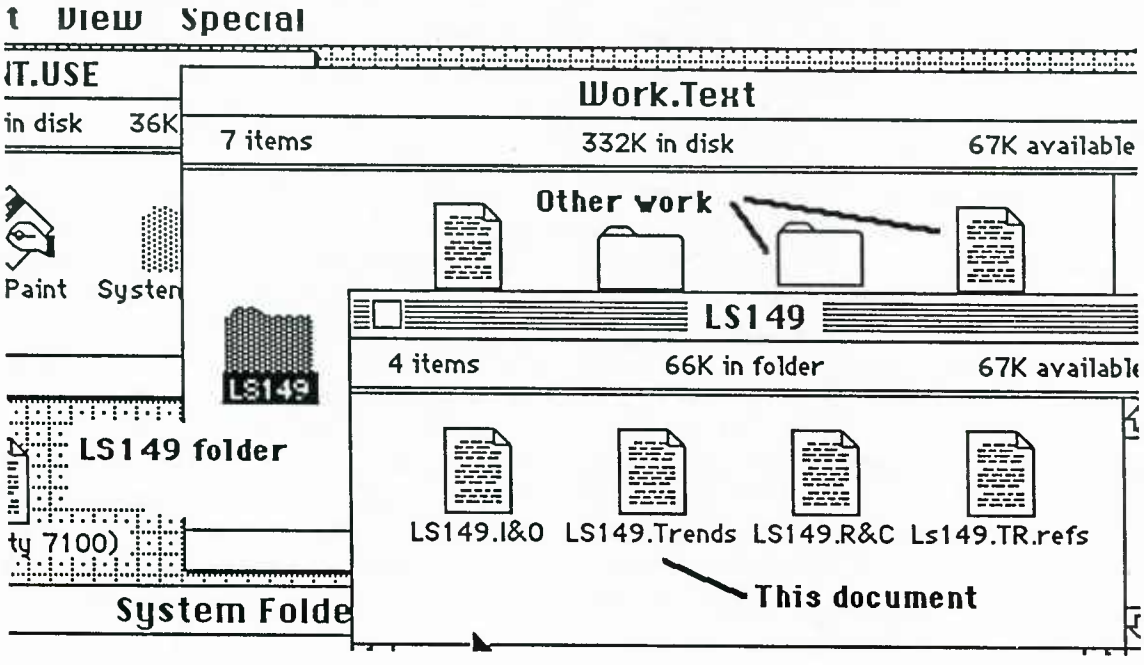

Figure 1 : Macintosh 'desk top' sample during work on this paper (Notes added in MacPaint)

An information specialist - any professional worker - may soon expect to be able to set up and use, with only a minimum of guidance apart from the system manuals and reading of published accounts of similar applications, a variety of micro computer based services including :

Word processing	for new text preparation
Text processing	to edit or reformat existing material
Publishing aids	for preparation of final documents
Electronic mail	to communicate with collegues
General communications	access to ASCII and videotext services
Spreadsheet	for accounting and simple modelling
Database	to store, retrieve and process sets of simple records
Graphical and pictorial aids	to prepare information in image, rather than text or tabular formats

The cost of providing such a work station will fall in the range of one fifth to one third of the annual salary and related charges for a mid-career specialist, or, if the life of the equipment is taken as five years, an additional charge of 6-10% in establishing the post. This may well be justified in document preparation and electronic mail savings alone (14).

Tasks related to information services which can be approached within this range of utilities exclude large scale text storage and retrieval; the 'production control' operations of high volume loans processing; the detailed specifics of extended entry cataloguing; and large scale periodicals control. Processes which can reasonably be automated on a modest scale will be limited mainly by the interest and initiative of the librarian or information officer, and clear candidates include :

Correspondence	Preparation of bulletins & bibliographies
Standard letters	Reference use of PRESTEL and similar services

Subscription management	Reference use of (public) electronic mail sources
Reports and papers	Access to on line bibliographic sources
Recall notices	Analysis of enquiries, loans, copying etc.
Budgets and accounts	Preparation & sending of ILL & other telexes

A tendency which may be worth watching is the inclination of larger software companies to absorb smaller, so reducing the range of products available while the content of individual systems increases. An article in May 1986 (15) identified more than twenty acquisitions in less than two years by five of the major producers based in North America, mostly of vendors of competitive or at least complementary products.

Access to facts

At the AGARD Conference in Munich in September 1981 (16) Viktor Hampel presented a challenging and thoughtful paper on 'Fact retrieval in the 1980s' in which he forecast that the convergence of computing and communications technologies in the late 1970s would lead to rapidly increasing use of systems which presented real answers to queries, rather than bibliographic pointers to where to search further. In particular he expected users to do much of their own searching, bypassing librarians as intermediaries; information to be presented as integrated text, numeric data and graphics; fact (principally numeric) databases to overtake bibliographic services in numbers; protocol conversion between disparate software and hardware assemblies to become straightforward; and access methods to incorporate an increasing range of aids and 'artificial intelligence' devices. Most of these projections appear to have been well-judged, including the challenge to the role of the librarian (17); how they will affect the information specialist in a **micro** computer environment is considered below. (Hampel also showed considerable enthusiasm for the potential value of holographic and other projective methods of showing structurally organised data such as molecular models and space maps, but these seem to have developed mainly in the minicomputer field, maybe due to the high computational loads involved in handling data in three or more dimensions.)

It is now clear that the separation between central information storage and local manipulation envisaged by Hampel, and in the form of 'information centres' by Martin, (18), is well established. Information centres deliver data selections to users' micro computers, where the raw material is then transformed on spreadsheets or word processors into the final form required for application. The underlying argument is to let the computer professionals look after the building, integrity checking and maintenance of databases, while the users - who are equally professional, but in the field of application - retain responsibility for the details of manipulation and presentation. One immediate effect is usually a sharp reduction in the number of complex, unsatisfactory and unmaintainable programs trying to reproduce mechanically the processes in the mind of the practitioner, and their replacement by **interactive** use of much simpler general utilities. An important aspect of current work in artificial intelligence research is the attempt to retain this flexibility of interpetation, while reducing the dependence on the skilled practitioner to deliver acceptable results.

The recognition that realistic presentation of fact information often involves the integration of text, numeric and tabular data and images, has been slow to penetrate from conventional publishing - where it is regarded as self-evident - to computer based information services, which have been inhibited by difficulties of mixed modes in databases, of image and graphic presentation on visual displays, and of dealing with the surprisingly awkward requirements of 'page' makeup for easy comprehension and interpretation. The next useful steps at least so far as micro computers are concerned, are likely to come from two sources, namely, a number of developments in 'electronic publishing', and progress towards database systems which handle both text and numeric data equally flexibly. Three recent conferences, in Europe but with many North American contributions, have addressed these topics - Protext II, Dublin, October 1985; Institute of Information Scientists, Southern Branch, London, November 1985; and the British Computer Society, Electronic Publishing Specialist Group, Nottingham, April 1986 (19, 20, 21).

The term 'electronic publishing' is being used to bring together a number of different but related activities, for which the common thread is the creation, storage and presentation of documents by means of computer or communications technology. In one sense it can be used to describe new developments in the publishing of learned journals, where articles are held as discrete entities to be retrieved 'on demand' by readers, either from citations and reviews, or by subject searching. The role of the publisher remains entrepreneurial, selecting material, encouraging authors, maintaining standards by peer review, and earning revenue from the service

provided to the research community (22). Alternatively, it can mean the preparation and typesetting, using new, low cost technology, of papers such as this, which can now be seen from initial drafting to camera ready copy by the author. This extends to a wide range of documents - data sheets, manuals, procedures, technical and research reports - which contain and make available the substantive internal information of an organisation. Yet again, and now linked to 'office automation', electronic publishing may be seen to address problems of format and style in inter-office communications, and the establishment of reliable practices for the allocation of subject and provenance terms, security, and retention life for conventional administrative papers.

The technical components of electronic publishing systems are some form of database handling system (discussed later); mark up conventions to control the way in which sequences of text and other matter are typeset; document architectures to describe the layout and structure of pages and whole products; and an identity system which adds subject, author and provenance data to documents in a predictable and authoritative manner so that subsequent retrieval from electronic (or even conventional) storage is reasonable reliable and efficient. These components overlap, with 'mark up' being defined by some workers to include architectural aspects and subject attributes. Here, mark up is generally restricted to control of founts, sizes, margins, etc., essentially as found in a word processing or typesetting system, but excluding the features which lead to semantic subdivision (abstract, references, list of figures) and comprise the architecture of the document, although no claim for consistency can be made at the present stage of development. It is also useful to distinguish between visual display directed text handlers which attempt to show final formats 'on screen', such as Macwrite in a simple way, and Interleaf at a more elegant level (19), and those command driven processors such as TEX (19) and PostScript (Adobe Systems, Ca), which embed control sequences within the text stream to be set. The former group, called, for short, WYZIWYG processors ('What you see is what you get') are easier to use for non professional composers, but the command driven methods are held by their proponents to offer finer control of the quality of the final document. The proceedings of the Protext II and BCS - EPSG Conferences (19, 21) offer interesting samples of what is produced by diverse researchers when they prepare camera ready copy for pre-print publication.

An early example of mark up combined with structure is the MARC standard for exchange of catalogue records (23). Here a complex set of conventions divides a bibliographic record into its principal components (author, title, publisher, series . . . . .), and further subdivides these main elements into fine detail, such as 'personal author', surname, date of birth, etc. The fine level codes may then be translated into the typographic conventions for the printing of a stylised bibliography - where field 245 Subfield $b (subtitle) inserts the '□:□' convention for separating title proper from its addendum (□ to mean 'blank'). In search and retrieval on MARC databasers, the (essentially typographic) mark up conventions provide convenient semantic subdivisions for the user, so that, for example, 'penguin' in alternative author, title, publisher and series roles may be distinguished. MARC also incorporates among its many 'tags' formal descriptors of the record itself, standard subject references, language codes and references to other, related records. It is, however, codified in the computing style of the late 1960s, and is complex, difficult to learn for occasional users, and, though clearly a success for the large scale transfer of records among national libraries and major academic collections, arguably somewhat rococo when carried into the practice of small to medium scale special libraries . The free text storage and retrieval systems manage on much simpler conventions, STATUS, for example, using the set of $$T, $$N, $$P, $$S, $$K, $$A, $$Z, and # together with users' (usually meaningful) text tags to handle a wide variety of records (24).

A much more recent, and actively developing convention is SGML (Standard Generic Markup Language). SGML (formerly GML) incorporates research by IBM together with contributions from a number of other sources, and is now well on its way to establishment as an OSI standard for mark up (25). The United Kingdom representative is the National Computing Centre, Manchester. The core of SGML is a set of conventional parameters which may be used to define either, or more usually both, a document structure and the rules for typographic expression of its content.

For example :

SGML in bold

<r>
<fm>

<mt>REPORT OF THE SECOND MEETING OF .....FEBRUARY 1985
<au>Joan M. Smith
<af>National Computing Centre, Manchester
<mb>
<p>The venue for the second meeting of the European Chapter of the International SGML Users' Group was the Post House at Reading. It was hosted by .....

Figure 2 : Example of SGML syntax (After Joan M Smith, reference (26) page 115)

An extended discussion will be found in the papers of the PROTEXT II Conference, 1985 (26). The conventions allow for table format data, and for the incorporation of both vector preferably GKS (Graphical Kernel System, 27) and raster graphics from auxiliary files. Provision is also made within the syntax for the control fields of other systems to be embedded, so that STATUS markers might form part of SGML tags. Conversely, the more advanced command structured typesetters, such as TEX and TROFF, look as though they could treat SGML codes as 'macro' call names, and so offer compatibility, although so far as is known to the author, this has not yet been demonstrated. What is certainly required for SGML is, for each particular typesetting route, an interpreter to translate the generic codes of that language to the specific conventions needed for the device in use.

For the information specialist, the importance of such a standard is that once a document structure has been defined, and the particular parameters listed, retrieval processes can take advantage of the natural subdivisions in just the same way as a cataloguer searching a British Library bibliographic database may use the MARC fields, but in this case with a much more flexible and application oriented structure. The main limitation is that since SGML proceeds from mark up to structure, the process of **interpretation** of structure is likely to be non trivial for a computer program, and require skilled intervention in the setting up stage of each application.

Document architectures proceed from the opposite direction, establishing first a language to describe structure, and then embedding within the text and graphic elements of that structure commands for their typographic representation. A number are being worked on, but the current most likely ISO standard is ODA (Office Document Architecture). This was originally proposed by ECMA (European Computer Manufacturers Association) and has since been adopted by ISO. It is compatible with some implementations of Open Systems Interconnexion (28) and is seen by one analyst as a fairly hurried attempt to maintain some control over document standards for transmission over telecommunication networks before local developments become intractably diverse, so is receiving support from some of the European PTTs (29). ODA defines, together, the logical structure and the layout structure of a document. The logical structure is expressed as a hierarchy of components, selected from the classes such as chapter head, abstract, footnote and so on, and the attributes of the component class indicate the way the layout structure for that component - the content block - is to be expressed. Suitable SGML structures may be mapped into ODA if they contain information of compatible arrangement, and the logical structure may be used in the same way to assist in searching for documents by text elements bounded by structural markers (30).

When a document is constructed to some architectural plan, becoming a **specific** instance of a **generic** structure, it may exist in either of two forms, revisable text (RFT) or final form text (FFT). In the former case, all manipulative marks are available, and the text may be reformatted, revised or restructured more or less freely. In final form, all page formats have been allocated in a mapped (rather than parameter defined) form, and may no longer be varied. These distinctions are maintained in IBM's own document control procedures, where document packages may be transmitted under DIA (Document Interchange Architecture), processed under DCA(RFT), and printed or displayed from DCA(FFT). Within the DISOSS (Distributed Office System) environment, these structures are provided as services, and may be more or less concealed from the end user. IBMs commitment to DISOSS as a systems product has lead to both IBM and other manufacturers developing compatible interfaces on

micro computers which may be used either as terminals to a 370 series mainframe or as free standing work stations.

At present, the movement of word processor or typesetter documents into text databases is usually at least tedious, and the reverse is difficult or worse. The research on structures should ease both problems, especially if the standards become firm in the office automation projects where the majority of substantial technical documents will in future arise (14). The requirements for subject annotation of letters and memoranda, and for management of short term stores in office systems, are becoming better understood, (31, 32, 34), and should be progressively incorporated in manufacturers' stand ranges. Application of standards to document transmission should facilitate the wide interchange of 'fact' resources to which Viktor Hampel looked forward.

Integration of presentation

Much less progress has been made in the practical delivery of electronic equivalents to the conventional journal article. A conference on *Integrating text and non-text* in November 1985 (20) offered a number of papers on partial solutions and future plans, but little firm evidence of working systems which would both retrieve and present material containing text, tables and graphics to an acceptable standard, and there was a tendency to treat the computer typesetting of matter as though it was the major element of the problem, and so to under state the difficulties of retrieval and transmission (33). Apart from the present lack of software (at least in a developed state) to handle complex document retrieval - and this will probably soon be made good - there are several problems associated with data volumes and terminal equipment which will not be so readily overcome, at least on the scale of minicomputer equipment.

Text stored in electronic form normally occupies between eight and ten bits per character. This depends on the use of a coded representation of each letter, ASCII typically, so that, for example, letter V becomes 01010110 in internal storage. The use of text compression algorithms may reduce the volume required for storage by a factor of 30% or so, at the expense of extra computational load during input and output (35). (This is an option in, among a few others, the BRS SEARCH storage and retrieval software). If the character is held as an image, however, as part of a scanned page of text turned into a bit raster representation, it may occupy between 80 and 160 bits in storage, depending on the efficiency of the scanning and packing algorithms. Data in graphical form, but stored as generating information to construct vectors at the time of presentation occupies an intermediate position. A typical text document, containing ten pages of 2,500 characters would occupy about 25,000 bytes in ASCII format, 50,000 when inverted for indexing purposes, and 250,000 to 500,000 in image format. Until recently, the heavy storage requirements which resulted have discouraged incorporation of any but pure coded text in retrievable databases, and the majority of package systems assume this format.

Two solutions appear to be emerging, which overlap to some extent. The first, which is, on the whole, a main frame or minicomputer method, is to keep the various parts of a complex document if the most appropriate format for each type of data, text in ASCII, graphics is GKS or a similar form, images (when unavoidable) in bit map or raster format. The whole document is then assembled, more or less smoothly, when presentation is requested at an appropriate terminal. This approach underlies IBM's DISOSS strategy - which is certainly not, in its present form, micro computer oriented - and has been used in applications of STATUS (AERE Harwell Laboratories), at least on an experimental scale. Standard techniques of full text retrieval may be applied to the ASCII parts of the documents; some form of key linkage or document descriptor entry is usually necessary for the non-text or 'image of text' parts. The context in which this is most clearly a trying difficulty, is in office automation systems which must maintain computer retrievable 'files' of both internally generated and externally created records, without being able to influence very much the format or medium of the outside letters, data sheets, brochures, and so on.

The alternative, and in a somewhat paradoxical way this appears to be more promising for micro computer based applications, is to take advantage of the very large storage at low cost offered (or, perhaps, promised) by the several varieties of 'optical' disc. This is a large, complex and changing subject, of which at least one good technical survey is available, (36), but for present purposes it is sufficient to note the following :

Discs made by impressions of masters

- CD-ROM (compact disc, read only memory) offers about 600 million characters (MB) of effective space for textual data; reading devices are (will be) cheap - $1,000 maybe; the size offers lots of text but begins to look small for images - allowing for indexing overheads, approximately 120,000 or 12,000 pages (DIN A4 size) respectively; production of masters is unlikely to take less than ten days as it is a technically specialised process;

- DODS (Digital optical discs, mastered forms) offer 1-2Mb now, maybe 4Mb soon; reading devices are more costly, and maybe minicomputer rather than micro computer oriented; the storage space available is now realistic for substantial volumes of hybrid records; production of masters is still a batch bureau process;

Both of the above methods are substitutes for 'publishing' technologies, requiring organisation of a substantial body of information, producing a 'work' from it, and finding a market containing a sufficient number of consumers who want the same thing. Recent micro computer based demonstrations have mostly centred on CD ROM - the Grolier *Encyclopedia* (Activenture); *Knowledge Warehouse* (Mandarin); *Library of Congress Catalogue* (Sydney); various demonstration products by Silver Platter, Integrated Automation, and AERE Harwell Laboratories. On the DODS front, text plus pictures is handled in *Colleague* (BRS); and the Canadian National Library has a pilot project on view including text, slide show, images of scores and musical performances (37).

Development is limited by the lack of agreed standards for disc formats, but considerable effort is being expended to deal with this issue. The subsequent constraints are likely to be those of commercial publishing in a new medium, and the adaptation of retrieval software to run efficiently and respond to user needs in the large scale environment. AERE Harwell, for example, have found it worth while to invest several months of analysis, redesign and field testing in producing a CD ROM adapted version of their existing microSTATUS software; BRS (for SEARCH) and Battelle Laboratories (for BASIS) are believed to be equally committed.

Discs written by devices attached to a user's computer

- WOODS (Write Once Optical Discs) or WORMS (Write Once, Read Many times) are based on the larger disc format (1-2Mb) but are produced by erosion of surface marks 'on demand' on a dedicated peripheral device; this offers within institution origination, fast update responses by adding new and changed data, altering a magnetic disc index; the potential is there, but few applications are so far reported; the technology may well be superseded before it is established by.....

- Re-writable mass disc systems (not necessarily using purely optical technology) which are aimed more at the market for very large magnetic disc storage usits, but share the stability and reliability of the optical disc media; they are still in development, but may deliver a disc to replace the typical micro computer's 10Mb 'winchester' with a 100Mb or even 500Mb device in the same housing.

These forms of optical disc are essentially local storage systems rather than 'publishing' media, since each copy must be separately written. (Compare audio discs, which are pressed, with cassete tapes which are copied.) In consequence, they may fit into either a selective publishing strategy, or some variant of the 'piecing different formats together when needed' approach discussed as a minicomputer or main frame technique above.

Terminal equipment is a much less satisfactory subject. Visual display units of the common, low cost, 80 by 30 characters display variety, provide in 'graphics' mode an image density on the screen of only 30 to 40 points per cm. (70 to 100 points per inch). This provides crude representation of line graphics, recognisable ghosts of half tone pictures, and a range of undesirable staggered diagonal lines, moiré patterns and angular, illegible text. For much more money - $5,000 or more, the raster density may be improved by a factor of two, which is still much rougher than would be acceptable on a printed page. Beyond this level, costs increase very sharply indeed. Printers, on the other hand, and especially laser printers using electrostatic transfer or surface etching techniques, now deliver 120 points per cm. (300 points per inch) for prices as low as $3,000. This is adequate for many - non precision - purposes, even though typographers working with electronic media usually require 500 to 700 points per cm. (1200 to 1800 points per inch) for journal or book quality, and some go to specialist filmsetters with 1,000 points per cm. or more (38).

A further complication is that the fount most legible on screen may not correspond to that desired in print. This paper was written in nominal 10 point Geneva, a san serif fount, to maintain legibility on the Macintosh 20cm. (8 inch) diagonal screen and still show a 90 character line length close to the eventual setting. The roman fount used for the final print is much more legible on paper, but quite unusable on the screen under the same conditions. On a much more professional level, a team based on Stamford University have developed a completely new family of types called Lucida, especially to make the best of visual display conditions (39). This is clearly successful on screen, but a number of those who saw both the visual display and printed versions at the BCS Nottingham Conference in April 1986 (21) were disappointed that the print version, though legible, was visually less attractive.

There seems to be no ready answer to this group of problems, and they may be around for some years.

Text retrieval techniques

After a few years of consolidation rather than innovation, there are several new developments and some interesting research in retrieval techniques. Some are, as yet, confined to main frames and minicomputers, but experience suggests that they will migrate to the larger micro computers before too long. (For background on the technology underlying present systems see references 33, 40 and 41. For a useful survey of possible, though not necessarily practical methods, and a useful bibliography, see 40.)

Several of the existing 'package' systems using inverse file techniques have been successfully converted to micro computer versions, retaining the major part of their functional scope. These include ASSASSIN, BASIS, CAIRS, SEARCH and STATUS. At the same time, large machine versions of these packages have continued to evolve, and developments are in hand to deal with ever larger databases ('difficult' is now about 600Mb); to deal smoothly with embedded mark up; and to handle very large simultaneous user populations. Portability across diverse makes of computer has been aided in some cases by the provision of UNIX operating system versions, although the flexibility of this method is somewhat constrained by the number of slightly different UNIX implementations from one manufacturer to another.

One system, INFOText, has for several years successfully incorporated text storage and retrieval within a relational database (Doric Computer Services in UK, Henco Inc. in North America). This concept has now spread to a new Battelle product - DM - which is primarily a relational database manager, but adds a range of text facilities similar to BASIS though more limited in scope. TRIP, a new version of 3RIP (Paralog AB) is based on a relational database infrastructure, although to the user it appears more like a conventional inverse file processor. MIMER (MIMER Information Systems AB, Savant in UK) has added to its established relational DBMS an extension to handle a parallel text database, although the degree of integration of relational and text records is limited. ORACLE Corporation (UK) Ltd are believed to be investigating the possibility of complete integration of text management, and extension of their version of the SQL query language, so that ORACLE users may move in and out of text segments in databases without any evident discontinuity. Applications in the library such as map catalogues, drawings indexes, issue systems are natural candidates for this sort of software (33).

Of the structured or hierarchical database products, INQUIRE (Infodata Systems Inc.) has had text facilities for some time, steadily increasing in scope; ADABAS (Software AG) has recently added a text module to the suite. The response of STATUS has been interesting, as the Harwell development group has chosen, rather than incorporating a wide range of structure features beyond the existing 'keyed fields', to make it easy to run STATUS in conjunction with a variety of other database systems, using CALL gateways from inside the text handling dialogue to access the other software. Hybrids with INFO, FOCUS and IDMS (at least) are believed to be in satisfactory operation, as well as more specialised calls to graphics software and to Harwell's TSSD typesetting package.

The use of text elements other than whole 'words', either to produce equifrequent fragments for compression and improvement of retrieval efficiency (35), or to build vector 'signatures' to represent documents (40) has recently been rediscovered, or at least revived. A direct application of the 'text fragment' strategies developed by Lynch's group at Sheffield University has been implemented within TRIP, as a 'very inverted file' of short fragments derived from the dictionary of words found in the text. This VIF index allows pre- and post- truncation of search terms as well as missing out of internal characters, because the resulting fragments may still be matched with

candidate words from the dictionary, at some processing cost, but potentially with a large gain in flexibility. TRIP is still very new, and users' experience with this facility will be a valuable test of the underlying theory.

Lynch fragments are selected based on a statistical analysis of the frequencies of all runs of up to, say, three letters within a text sample similar to the target database. A more general 'signature' approach maps either whole words on to a standard vocabulary of terms (usually with stemming to reduce inflexion diversity), or maps fixed length strings of characters onto a list of preferred strings (40). In either case a signature consisting of a series of bits, 0 for *absent*, 1 for *present* is constructed, and characterises the vocabulary of the document. If similar processes are applied to *queries*, then sequential comparison of query signatures with document signatures gives probable candidates for matching, which is then performed by direct comparison of terms with texts. The salient advantage is a great saving in the cost of updating of inverse file structures, especially online; the main problem is that the user does not easily see the working vocabulary, so that it is most useful with stylised languages. Practical implementations so far are TSIP (Systems Designers Limited) in software; COLOSSUS (Datafusion Inc.) in associative processing hardware. The use of an associative processor is claimed to extend the practical usefulness of the signature approach from 2Mb files to at least 50Mb. There is also a recognised, but as yet unproven application of signatures in identification of *duplicate* records in archival databases. Some recently reported research (42) on the use of text signatures to determine 'nearest neighbours' in a set of documents suggests that the process of *reduction* inherent in forming bit string signatures may make practical some theoretically attractive methods of clustering and retrieving records, which were previously intractable due to computational load. This could extend the application of such approaches in electronic office data management in particular.

. . . . and some unsystematic ideas

The following items may or may not turn into practical products. For the present they are merely noted as items to watch for in the technical press:

- The Department of Information Studies in Sheffield University has implemented a teaching system called INSTRUCT as a 'test bed' for ideas like ranking of search results; search term association and expansion; term weighting. (Papers due in **program** soon.)

- Digitisers for micro computer systems like the Macintosh are becoming very cheap. The simple Thunderscan device fits on to the matrix printer carriage and delivers MacPaint format images; it costs about £250 in UK. A more advanced device, the Abaton SCAN 300, offering a resolution of 300 points per linear inch costs more, but is comparable with a laser printer. One might therefore consider a Macintosh with a scanner and communications software (VICOM costs £150 in UK and a modem £250) as a fairly powerful facsimile terminal. It costs more than a dedicated FAX machine, but it happens to incorporate word processing, database, spreadsheet and so on already.

- Spelling checkers, now available in many word processors, can be adapted to offer alternative *spellings*, and so can be used to store alternative *language* versions of keywords in low cost multilingual glossaries.

This list will undoubtedly have grown between the date of preparation of the paper (May 1986) and presentation - so there will be more in the final version of the paper !

References

1 P F Burton & J H Petrie. *Introducing microcomputers : a guide for librarians.* Wokingham : Van Nostrand, 1984

2 H Gates. *A directory of library software for microcomputers.* Aldershot, Hants., and Brookfield, Vt.: Gower, 1985

3 P D Gratton. *Automation in Derbyshire County Libraries.* London : The Library Association, 1983

4 VINE nos. 27, 31. VINE is published by the Information Technology Centre, London, supported by the British Library

5 VINE no. 48

6 VINE nos. 41, 48

7 FIRS : a free text information retrieval system for microcomputers (FIRS *now* MIRABILIS!) **program** news item, vol. 16 no. 1, January 1982

8 J H Ashford. Information storage and retrieval systems on mainframes and minicomputers : a comparison of text retrieval packages available in UK. **program**, vol. 18 no. 2, April 1984

9 *UK Micro Marketplace - annual review 1985.* Maidenhead : Romtec, 1985.
(From report in PC Week, 1st May 1986)

10 P F Burton & H Gates. Library software for microcomputers. **program**, vol. 19 no.1, January 1985

11 R F Guy & T P Cairnes. The production of printed indexes by microcomputer.
Electronic Library, vol. 3 no. 5, December 1985

12 M Rowbottom. Use of microcomputers in public libraries.
Library Micromation News, no.6, October 1984

13 P J Brown. A simple mechanism for authorship of dynamic documents. *In* (21)

14 A Paterson. *Office systems : planning, procurement and implementation.*
Chichester : Ellis Horwood; New York : Wiley, 1985

15 G Black. Takeover fever rages in software. Computer Weekly, 1st May 1986

16 V E Hampel. Fact retrieval in the 1980's. (in) *What should users expect from information storage and retrieval systems of the 1980's?* AGARD Conference Proceedings No. 304, Munich 1981.
Neuilly-sur-Seine : AGARD.

17 J Gurnsey. *The information professions in the information age.*
London : Clive Bingley, 1985

18 J Martin. *An information systems manifesto.*
Englewood Cliffs; NJ, London : Prentice-Hall, 1984

19 *PROTEXT II : Proceedings of the Second International Conference on Text Processing Systems.* 23–25 October 1985, Dublin, Ireland. Dublin : Boole Press, 1985

20 *Integrating text and non-text.* Proceedings of the Institute of Information Scientists Conference, London, November, 1985. London : Taylor Graham, 1986

21 *Text processing and document manipulation.* Proceedings of the International Conference, University of Nottingham, 14-16 April, 1986 (British Computer Society Workshop series). Cambridge : Cambridge University Press, 1986

22 J Kircz. Will physics publishing survive the electronic challenge? *In* (19)

23 *UK MARC Manual.* London : The British Library, 1980 *and looseleaf revisions to 1986.*

24 D I Matkin and J H Ashford. A review of the applications of STATUS in July 1982. *In Information Technology in 1982.* (LA Conference Proceedings Series in Library Automation) London : The Library Association, 1982

25 Information processing systems - text and office systems - Standard Generalised Markup Language (SGML) : ISO/DIS 8879

26 J M Smith. Introduction to the Standard Generalised Markup Language. *In PROTEXT II : Proceedings of the Second International Conference on Text Processing Systems - Workshop Notes.* 23–25 October 1985, Dublin, Ireland. Dublin : Boole Press, 1985

27 Specification for a set of functions for computer graphics programming, the Graphical Kernel System (GKS) : BS 6390; ISO 7942

28 Description of Basic Reference Model for Open Systems Interconnection : BS 6568; ISO 7498

29 V Joboloff. Trends and standards in document representation. *In* (21)

30 M H Kay. Textmaster - document filing and retrieval using ODA. *In* (21)
(Also describes applications of ICL CAFS system in document retrieval)

31 M Zisman. Good fits, bad fits and misfits : making document interchange work. Computerworld, 21st January, 1985

32 J H Ashford. Document storage and retrieval in the electronic office.
Information Development, vol. 1 no. 2, April 1985

33 J H Ashford. Integrating text and non-text : why is it important? *In* (20)

34 G Seddon. Information retrieval as the core of office automation.
Journal of Information Science, vol. 8 no. 2, March 1984

35 G N Metcalfe (comp.) *File compaction techniques : a selective bibliography.*
Birmingham : BLCMP, 1977

36 T Hendley. *Videodiscs, compact discs and optical disc systems : an introduction .....*
Hatfield : Cimtech, 1985

37 R Duchene and S S Sonneman. *Optical disc technology and the library = Technologie du vidéodisque et La Bibliotheque.* Ottawa : National Library of Canada, 1985

38 R A Morris. Is what you see enough to get? : a description of the Interleaf publishing system. *In* (19)

39 C Bigelow and K Holmes. The design of Lucida : an integrated family of types for electronic literacy. *In* (21)

40 C Faloutsos. Access methods for text. ACM Computing Surveys, vol. 17 no.1 March 1985

41 R M Tagg. Bibliographic and commercial databases : contrasting approaches to data management with special reference to DBMS. **program**, vol. 16 no. 4, October 1982

42 K C Mohan and P Willett. Nearest neighbour searching in serial files using text signatures.
Journal of Information Science, vol. 11 no. 1, 1985

PROCUREMENT AND MANAGEMENT OF MICROCOMPUTER-BASED SYSTEMS

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Summary

Microcomputer-based systems appear to offer an inexpensive approach to library and information system automation. However, to be effective, efficient and cost-effective, it is still necessary to apply some well-established principles to the specification, and procurement of micro-based systems. The paper reviews the procurement process, indicating some of the difficulties associated with micro systems, such as evaluation of hardware and software, and the difficulties of finding suitable software. Once installed, a micro-computer system can provide a number of management problems, caused, not least, by the inexperience of operators and the "direct" impact of the systems (as compared with large systems, which are often supported and operated by qualified personnel).

Recommendations on effective installation and management are provided.

Introduction

The advent of the microcomputer provided many library and information service managers with the opportunity to automate at relatively low cost. Unfortunately, and largely as a consequence of that low cost, many time-honoured and valuable management techniques were pushed to one side. It seemed that it was unnecessary to expend large amounts of effort in systems analysis, cost-benefit or cost effectiveness analysis for such a low priced commodity: still less was it necessary to set up project teams to plan the introduction and implementation of microcomputer-based systems, or to maintain systems management personnel once the system was up and running.

This was unfortunate for a number of reasons. First of all, the microcomputer placed computing power in the hands of a relatively untrained group of people, and thereby placed on them the onus of successful implementation, where previously this had been the task of data processing or similar staff. The individuals faced with this unfamiliar situation were precisely those who could most benefit from a knowledge and application of these basic techniques, in order to avoid the frustration of the initial high expectations. High expectations were, in turn, engendered by the apparent pervasiveness of microcomputers: they were, it was suggested, about to spread to every corner of life, and were capable of providing unheard-of facilities. For some, it seemed the millenium had arrived!

The low cost of microcomputers certainly militated against the use of established procurement and management techniques, though developments rapidly showed how necessary they still were. It remains true that microcomputers offer inexpensive computing power of some magnitude. However, it soon became apparent that in order to apply them on a large scale in library and information services (LIS), correspondingly large-scale systems had to be used. The £2000, 32K or 48K system with twin floppy disk drives was severely limited in its potential within LIS and it soon became apparent that larger memories and hard disks were required in order to mount applications such as large databases, circulation control and online catalogues. This, of course, meant increased costs and simply made it more necessary properly to plan the introduction of microcomputer-based systems.

Obtaining and successfully implementing a microcomputer-based system falls naturally into two processes, as suggested by the title of this paper - procurement and management. Both can pose problems for the LIS manager but these can be overcome with proper planning.

Procurement

Proper planning extends to the procurement process, although it must be said that for many LIS managers, the purchase of a microcomputer is often precipitated by the provision of extra funds at the end of the financial year, or by a "generous" authority which provides a microcomputer with the injunction to "put it to work"! It seems that a number of LIS have obtained their microcomputers in this way, only to wonder next what can be done!

Ideally, microcomputer-based automation should begin with the analysis of the application or applications which it is hoped to automate.[1] This analysis can be based on a number of factors, including:

(a) the reasons for automation (e.g., time saving, extension of the service)
(b) a quantitative analysis of the system (e.g., number and size of files or records involved)
(c) how the files will be used (e.g., only online or with printed versions)
(d) who will use the system (trained staff or occasional users)
(e) necessary and "desirable" functions
(f) level of integration with other software

computer journals, while the professional library and information science journals include reports from existing users on packages. There are now a number of journals which specialise in the application of microcomputers to LIS and these in particular are a valuable source of information about candidate programs. These journals include:

Electronic Library (Learned Information, Besselsleigh Road, Oxford)
Library Micromation News (Library Technology Centre, Polytechnic of Central London, 309 Regent Street, London W1R 8AL)
Library Software Review (Meckler Publishing, 11 Ferry Lane West, Westport, CT 06880)
Microcomputers for Information Management (Ablex Publishing, Norwood, New Jersey 07648)
Small Computers in libraries (Graduate Library School, University of Arizona, Tucson AZ 85721)

As was suggested earlier, these journals provide not only reviews of new packages, but also carry reports written by users describing their experiences with various programs: they are therefore an invaluable source of information, second only to hands-on working with the program itself. Briefer details can also be derived from a number of printed and online information sources, including:

Computer Database (online from Dialog)
Micro Software Report (Nolan Management Associates; annual)
Micro Software Evaluations (Nolan Management Associates)
Microcomputer Index (online from Dialog)

Of the two annuals from Nolan Management Associates, that containing evaluations is the more useful, since these are written by practicing librarians who have used the software.

In addition to these published sources, there are various organisations which can offer advice and/or details of programs.
These include:

Library Technology Centre
Aslib Information Services
British Computer Society
National Computing Centre

The depth of advice, etc. available varies from one organisation to another, but again would serve to eliminate unsuitable software at an early stage in the investigation. The Library Technology Centre, for example, can offer comment on packages, can put the enquirer in touch with users, and frequently organises demonstrations of specific LIS-related programs. Demonstrations can also be "booked" in advance by interested individuals.

Having consulted some or all of these sources, the LIS manager will be able to draw up a short list of candidate programs for more detailed investigation and assessment. There are various ways in which software can be assessed, while various factors relating to the software and its supply should be taken into account. Demonstrations of software can usually be arranged by a supplier and these are a useful way of assessing the potential of the candidate software. However, it will be necessary to bear in mind that such demonstrations will rarely (if ever) be using large files of data or information and so their speed of operatin and general information handling capabilities can only be estimated. A demonstration will provide the opportunity to assess how user friendly the program is and the overall ease with which it can be used. It will also be important to bear in mind that a supplier may be an agent for a particular package and so will be more interested in selling that one rather than any other which is on the LIS manager's "shopping list".

Demonstration disks suffer from the same problem of only handling limited file sizes, but do give the prospective buyer the opportunity to examine the package in-house and using "real" and relevant data. The cost of demonstration disks is normally deducted from the full cost of the software, and the initial outlay is relatively modest.

The standing of the supplier is also a factor to take into account at this stage. His reliability and reputation are important, since he can be a source of advice and trouble-shooting in the early days of implementation, and may be responsible for the installation of the software once it is purchased. The LIS manager should establish precisely what level of support the supplier can offer, and at what cost, though it is necessary to be To begin the selection process the LIS manager must start with a list of potential packages, i.e., programs which appear to be suitable for the application under investigation. There exists, however, a problem even at this early stage in identifying these candidate programs. There is no true "bibliographic control" over software, and so a centralised and comprehensive source of information is lacking at present. There are a number of reference sources which can be consulted, and given that no single source can yet be said to be comprehensive more than one will have to be used.

Advertisements and reviews in appropriate journals at least provide an up-to-date coverage of contemporary software, though advertisements will have to be treated cautiously. Supporting literature will provide some detail and will allow the LIS manager to discard some of the candidates at an early stage. Reviews are published by most of the micro-

This analysis, and the subsequent investigation and choice of software and hardware, may not always justify the setting up of a project team, as would normally be the case with larger automation projects. (Indeed, the personnel may not be available). In many cases, the "team" may simply be the LIS manager and (perhaps) one other member of the staff, but the methodical approach offers many advantages. Following on from the analysis outlined above, it will be possible to define the overall project in terms of objectives to be achieved and thus to divide the entire project into manageable sections which can normally be tackled one at a time.

If the LIS manager (as distinct from the parent organisation) is the prime mover in the investigation, the analysis will also provide the early detail usually required to convince the purse holders of the value of what is proposed. In other words, the LIS manager will be able to indicate what savings (in time and/or money) will be possible, the degree to which the service can be extended and the reasons for automating, as well, perhaps, as indicating some approximate and first order costs.

Clearly, the resources which can be devoted to a project will reflect the likely cost of equipment and the anticipated savings and benefits. It is unlikely, for example, that consultants would be brought in for any but the larger projects, though their use cannot be ruled out, particularly at the equipment procurement stage. It will certainly be important to include LIS staff who will ultimately operate the new system and who will be working "at the sharp end". Representatives of these staff will be able, from the earliest days of the project, to advise on actual practices and on the practicality of proposals. The participation of staff in this way also has a major role to play in allaying worries about the proposed system and in reducing any conflict which may occur.[2] Change is a stressful time for all concerned, and change associated with computer-based systems seems to generate more stress than most other events.[3] Reactions to automation may often be negative, and may be based on fears about job security, de-skilling, and "technophobia", or they may be less firmly grounded. Nevertheless, these fears are genuinely felt by those concerned and should not be construed simply as opposition or be dismissed without further thought.

After this initial phase of the project, it will be possible to move to the next step, armed with a detailed specification of requirements for the application. At this point, the LIS manager will be faced with a number of methods by which the particular application could be implemented. He could consider:

(a) a custom-built system, specifically tailored to the LIS's requirements
(b) development of a system in-house, using expertise either within the LIS or the parent organisation
(c) a turnkey system, i.e., a complete hardware/software package, perhaps with some modification to suit local needs
(d) off-the-shelf software and hardware (probably with little or no modification)

For microcomputer-based systems and the majority of LIS, the last option will probably constitute the only realistic approach, and the LIS manager will now be ready to go out into the market place to obtain a system. At this point, we should note, that standard practice is to select the required software first and only then to procure the hardware. Buying the hardware first can pose unnecessary limitations on the software and therefore on what can be done, though it has to be said that contemporary software is usually designed to run on a range of microcomputers, and the limitations are not what they once were.

Going into the market place for software is a task which can be eased by the use of a checklist of the requirements for the application. A checklist will contain all the features deemed necessary for the application under investigation, perhaps with an indication of those features which are essential and those which can only be considered desirable or useful. The checklist can also allow for information on the hardware required for each software package, so that a total picture can be constructed of the application and its implications. Checklists of this nature can be constructed for each package examined, though this makes "at a glance" comparison less easy, and a summary chart may also be required. Obviously, the features listed on the checklist will vary for each application, since the requirements of an information retrieval system will not be the same as those for word processing, but it is during the analysis stage that these details will come to light. Practical assistance in this can be gained from the numerous surveys of software which have been carried out by the microcomputer journals, almost all of which publish, from time to time, summary charts for various types of software. These summaries can be used as a model by the LIS manager, though naturally, for LIS-specific programs, he will have to consult the professional journals in order to gain an overall picture of the facilities which are available from these programs.

realistic in this respect: inexpensive software may have little or no "after-sales service", though support should be available for more expensive packages, and this support should include advice, troubleshooting, perhaps some degree of operator training and some provision of updates to the program (which may be free or at reduced cost). The cost of this support should be included in the overall investigation, of course, and it is not unknown for it to be as much as one-third of the total purchase price. Comment on the supplier and his reputation can be obtained from existing users, and a good supplier should be willing to put the LIS manager in contact with users (either directly or indirectly). A visit to these users is to be recommended, because it is an opportunity to obtain comments about the supplier and to see candidate program in use: even if this is not an LIS context, it will provide more concrete evidence about the software in use in a working environment.

The documentation for the software should also be examined carefully. Notwithstanding the earlier remarks about supplier support, the documentation will be the principal source of information about the day-to-day use of the program: if it is not clear and concise, a great deal of wasted time and frustration will result. Ideally, documentation should include a complete step by step guide for the beginner and a reference manual for the more experienced user, who will have less need of detail (indeed, for whom too much detail will be equally frustrating). The user friendliness which was mentioned earlier is an overworked phrase which seems to mean all things to all men, but in summary it refers to:

(a) screen presentation of instructions
(b) error prevention and data recovery
(c) information on what is happening at any time
(d) confirmation of action

Instruction should be clear and unambiguous, ideally making use of (unique) mnemonics whenever possible in as natural a way as possible. Menus are a common approach when it is necessary to choose from a list of alternative actions, but even menus can vary in friendliness, and can become tiresome for the experienced operator. On the other hand, a command language is more flexible than a restricted menu choice, but has to be learned, and it is easier to make mistakes in a command language.

Error prevention in contemporary software produced fewer system crashes than was once the case: current practice is simply to display an error message, and then to allow the operator to enter the correct command or to make the correct choice. If a system does crash, it should be possible to recover the files as they were at the start of the session and most of the data entered prior to the crash, though this last may be more difficult.

Software should always indicate to the operator what is happening once an instruction has been keyed in, and should display warning messages if the action will result, for example, in data being erased from a disk, together with an opportunity to confirm the action. Messages such as "Data being written to disk", "Sorting" and so on are of great value, since they tell the operator that something is happening and that data have not been lost - unless, of course, the operator ignores the messages and still presses the wrong key!

A final point to consider in the assessment of candidate programs is the ability to link with other software. This is now not uncommon in business software, where, indeed, integrated packages of spreadsheet, DBMS and word processor are already available, and it is becoming a feature of LIS-specific programs, when modules for acquisitions, cataloguing, online catalogues, circulation control and serials management are provided. These can be bought en bloc or as individual programs, but the user knows that they will operate with the same records, thus eliminating much duplication of keyboarding and files.

Many of the comments relating to software can be made about hardware as well. It may be the case that the program finally selected will only run on one type or model of microcomputer, though often nowadays there is more choice than this. Hardware can be selected on the basis of:

(a) ergonomics and ease of use
(b) availability of additional peripherals
(c) cost
(d) availability of support and maintenance

These may not be the only considerations in any given situation, of course, and local requirements may have to be taken into account (e.g., discounts available on certain products).

Once through this assessment process, the LIS manager will have a set of checklists which he and the project team can analyse in order to arrive at a conclusion about which software and hardware combination best suits the application. It has, of course, to be said that even then the manager may be faced with a choice (if only from two systems): in this case, it is likely that more intangible factors will come into operation about which it is difficult to pontificate. The intuitive, gut reaction is not to be ignored in such circumstances!

Once the choice is made, the order placed and the system delivered, the LIS manager will then be in the position of implementing the new system, though some thought will have been given to this before the event, so that there are a few as possible unforseen circumstances to overcome.

Management

Prior to delivery and installation, the LIS manager will have considered the ways in which the newly automated service can be implemented. To some extent this will be determined by the application, but normally two alternatives will be available - to change over to the new system completely and in one move, or to convert large or important areas of the application first and then to work on the remaining areas in response to demonstrated need. An online catalogue, for example, could contain the most recent material added to stock or that which loan records identify as the most used (based on some relevant criterion). Once those records have been added to the new catalogue, further investigation will reveal the next level of in-demand material, and records for those items can be converted.

Alternatively, the LIS manager may decide to convert only those records for in-demand material, and then to run the online catalogue alongside the existing card or fiche catalogue, which will gradually become less and less used, as more and more material is added to the online catalogue.

It is unlikely, however, that such an arrangement will be suitable for a circulation control system. In this case, it will be necessary to convert all records, prepare and test the application and then to change over to the new system, simultaneously discarding the old. In both cases, however, it is vital that the application be thoroughly tested before "going public": better to delay the grand opening for a while, than to use the LIS users to debug the system in operation!

The period before going live should also be used for detailed staff training and the final stages in the preparation of operations manuals, which will be a necessary complement to the system documentation. Operations manuals cover the detailed working of the system on a day-to-day basis, and so are unique to the LIS. They need not duplicate the supplier's documentation, though they can simplify it where appropriate, with reference to the documentation as needed. Operations manuals should be prepared as far in advance as possible, drawing on the advice of LIS staff. If they are distributed to the relevant staff in advance, this gives the staff time to assimilate the instructions, to clarify uncertainties and to gain an overall view of the changes. Test runs using the operations manuals will show up any inconsistencies, inadequacies and omissions which can be rectified and re-tested. The operations manuals should contain detailed and relevant examples from the work of the LIS, and should be retain for future reference and use by new staff.

It will be clear from this that the manuals should not, however, be regarded as tablets of stone: testing and even daily operation may show up necessary changes, and an appropriate feedback mechanism should be devised to allow the system's operators to provide comments and suggestions. A useful technique is to designate a settling in or "shake-down" period when operations are monitored and improvements made through the feedback mechanism. This period should be accepted as an unsettling one, when change will be the order of the day, but properly handled, it will allow all LIS staff to play a constructive part in developing the new system. All of this can be made easier if one person is responsible for the preparation of operating instructions and for assimilating the comments and feedback from staff. This ensures that a visible and unobstructed line of communication exists, so that delay is minimised.

The exact character of staff training will depend largely on the application: some can be learned in use, with due allowance being made for mistakes and delays, but for other applications (such as the circulation control mentioned earlier), staff must be familiar with operations before any attempt is made to "go public". This will also mean that some time must be set aside for regular training sessions during the normal day. Training sessions can also re-inforce the reasons for the introduction of the new system, not only for those who may have forgotten, but also for any new staff who may have been appointed in the interval between investigation and purchase.

Finally, the LIS manager has to consider some of the physical aspects of the management of the new system, ranging from care and maintenance of the hardware to appropriate system security.

There are, of course, some obvious precautions to take about the siting and protection of microcomputer systems. While they do not require the highly controlled environment of larger systems, they should be shielded from extremes of temperature, be protected from dust-laden atmospheres and be sited in situations where the display screens can be read easily and with no strain. This means that the ambient light must be suitable, with no distracting reflections. Static electricity is often a problem, since it can corrupt disks and screen displays, but it can usually be cured by the use of anti-static mats and the regular use of anti-static sprays, both of which are available from accessories suppliers. A major cause of data loss and system breakdown can be fluctuations in the power supply and if this is likely, it is worth installing a control pack between the mains supply and the microcomputer which will suppress power surges. This can often be allied to a battery powered back-up system which cuts in automatically should the power supply fail. This allows the operator to close down the files and system properly, ensuring that no data are lost.

The ergonomic and health and safety considerations relating to microcomputer systems are the subject of much debate at present[4]. Muscular strain, headaches and adverse effects on vision can be minimised with properly designed furniture and surroundings, and in many organisations it is now customary to provide the users of microcomputers and similar equipment with the opportunity for a break approximately every two hours. This allows the operator to rest the eyes and the most-used muscles. Potentially more serious is the suggestion that the operation of microcomputers and other VDU-based systems is linked with miscarriages and birth defects in pregnant women. The suggestion is that low frequency radiation from VDU's is the causal agent, but the evidence is far from clear at the moment. However, many organisations now offer pregnant women the opportunity to do other work which does not involve VDU systems.

Security of data stored on a microcomputer-based system has two major aspects, namely, the physical security of the disks or other storage device and the need to protect the data from unauthorised access and amendment. Physical security can be improved by ensuring that regular backups are taken of data disks, either by backing up onto floppy disks, or, in the case of hard disks, onto tape streamers. Backups should be made (ideally) where-

ever large amounts of new data have been added, and the frequency with which this is done will depend on the application: circulation control system records may have to be copied daily, the catalogue less frequently. Word processing files should be saved and backed up at regular intervals during their preparation.

A policy for appropriate backup measures should be devised for each application and should be adhered to scrupulously. Master and backup copies should be easily distinguished and, where these are removable, should be stored securely when not in use, away from dust, magnetic sources and extremes of temperature. It is good practice to store backup copies separately, but conveniently: nothing will deter operators from making backup copies so easily as an awkward and time-consuming procedure. It is common practice for software suppliers to provide a working copy of the program disk along with the master or distribution copy. If the supplier does not do this, he will normally provide instructions on how to make an authorised copy for day-to-day purposes. In either case, the master copy should also be stored securely and safely, and be clearly identified. A policy of restricting the use of master copies to the provision of working copies is advisable, and it may be worthwhile to restrict access to master copies to those who can authorise the making of copies where necessary.

The protection of data from unauthorised access or changing may be necessary for many reasons. It is obviously undesirable to allow users the opportunity to change catalogue records, but free access is necessary. Most contemporary LIS-specific software incorporates the required levels of security, such that a password is required before changes can be made to a record, although everyone is free to view the records on file. The authority to chance records may, of course, be limited within the LIS: presumably only staff of the cataloguing section would be allowed to change catalogue records. In some instances, software provides facilities to ensure that unauthorised users can see only part of a record. Thus, a full bibliographic record may contain all the details of ordering, supplier, price, etc., but these would not be displayed to the LIS user.

Circulation control records, of course, are covered by the Data Protection Act in the UK and may not be divulged to unauthorised individuals. Since it is also an offence under the Act not to protect such files from unauthorised access, it will be particularly important to ensure adequate security and to ensure that LIS staff are aware of the implications.

Conclusion

Acquiring, installing and maintaining microcomputer-based systems still calls for sound management techniques, if major mistakes are not to be made, which will result in frustration and time wasting on the part of both LIS staff and users. Although the low cost of microcomputer systems may not always justify large scale project teams and analyses, some ordered approach to their implementation is necessary. The microcomputer appeals to the smaller library, where (almost by definition) budgets are also low, therefore the price of a system forms a significant portion of that budget, and mistakes are still costly. A thoughtful, orderly attitude will ensure that this is avoided and that a successful system is implemented with the minimum of inconvenience to all concerned.

References

1. Antill, L. Secrets of systems analysis. **Personal Computer World** 3 (9) 1980. In 11 parts.

2. Mumford, E., Land, F. and Hawgood, J. A participative approach to the design of computer systems. **Impact of Science on Society** 28 (3) 1978. pp235-253.

3. Fine, S. Human factors and human consequences: opening commentary, in, **Information technology: critical choices for library decision-makers.** Edited by Allen Kent and Thomas J. Galvin. Dekker, 1982 (0-8247-1737-6). pp209-224.

4. Health and Safety Executive. **Working with VDU's.** Health and Safety Executive, 1986

THE APPLICATION OF MICROCOMPUTERS TO AEROSPACE AND DEFENCE SCIENTIFIC AND TECHNICAL INFORMATION WORK - LS 149

BIBLIOGRAPHIES

Two bibliographies have been prepared for this Lecture Series and since there is little (if any) overlap between them, both have been included in this publication.

The first bibliography was compiled by Paul F. Burton, Department of Information Science, Strathclyde Business School, University of Strathclyde, Glasgow G1 1XH. It is an edited version of the work 'Microcomputers in Libraries and Information Services: an Annotated Bibliography' and is reproduced here by arrangement with Gower Publishing.

This bibliography has the following sub-divisions:

The second bibliography was compiled by the Scientific and Technical Information Branch of the US National Aeronautics and Space Administration, Washington, D.C., in consultation with Richard W Hartt, Logistics Management Institute, Bethesda, Maryland, one of the Lecturers. It starts on page B-11 and is arranged in alphabetical order of author.

BIBLIOGRAPHIES, ETC.

Burton, P.F. Microcomputers in libraries and information services: an annotated bibliography. Gower, 1986.(ISBN 0-566-03540-5)

Gates, H. A directory of library and information retrieval software for microcomputers. Gower, 1985. (ISBN 0-566-03531-6)

Hamilton, C.D., Kimberley, R. and Smith, C.H. Text retrieval: a directory of software. Gower, 1985. (ISBN 0-566-03527-8). Supplement 1986

Pratt, A.D. Microcomputers in libraries, in, Annual Review of Information Science and Technology. Vol.19, 1984. Knowledge Industry, 1984. (ISBN 0-86729-093-5). pp247-269

GENERAL CONSIDERATIONS OF MICROCOMPUTER SYSTEMS

The application of mini- and micro-computers in information, documentation and libraries: proceedings of the International Conference...Tel-Aviv, Israel, 13-18 March 1983. Edited by Carl Keren and Linda Perlmutter. North Holland, 1983. (ISBN 0-444-86767-8)

Burton, P.F. and Petrie, J.H. Introducing microcomputers: a guide for librarians. 2nd ed. Van Nostrand Reinhold, 1986.

Cost estimates for integrated micro-systems. Library Systems Newsletter 4 (6) 1984. pp41-43

Costa, B. and Costa, M. A micro handbook for small libraries and media centers. Libraries Unlimited, 1983. (ISBN 0-87287-354-4).

Falk, H. Personal computers for libraries. Learned Information, 1985. (ISBN 0-938734-10-5)

Gillman, P.L. Microcomputers in special libraries: a means to an end? Electronic Library 2 (3) 1984. pp197-203

Griffiths, J-M. and King, D.W. New technologies and libraries: a framework for decision making. Microcomputers for Information Management 1 (2) 1984. pp95-107

Grosch, A.N. Configuring a professional microcomputer for information processing. Microcomputers for Information Management 1 (1) 1984. pp15-29

Kesner, R.M. and Jones, C.H. Microcomputer applications in libraries: a management tool for the 1980s and beyond. Aldwych Press, 1984. (ISBN 0-86172-039-3)

Leggate, P. and Dyer, H. The microcomputer in the library: 1. Introduction. Electronic Library 3 (3) 1985. pp200-209

Leggate, P. and Dyer, H. The microcomputer in the library: 2. Hardware and operating systems. Electronic Library 3 (4) 1985. pp260-274

Mazursky, A.D. Corporate policies for effective microcomputer use. Journal of Information Systems Management 1 (3) 1984. pp82-84

Megna, R.J. Solving big problems with small computers. Museum News 62 (1) 1983. pp61-66

Microcomputers for libraries: product review and procurement guide. James E. Rush Associates, 1984. (ISBN 0-912803-09-6)

Microcomputers in museums. Edited by Richard B. Light and D. Andrew Roberts. Museum Documentation Association, 1984. (MDA Occasional Paper 7). (ISBN 0-905963-50-4)

Rush, J.E. Evaluation of integrated online library systems: minis and micros. Parts 1 and 2, in, 2nd National Conference on Integrated Online Library Systems, 1984. pp306-323

Siedmann, A. and Arbel, A. Microcomputer selection process for organizational information management. Information and Management 7 (6) 1984. pp317-329

Walton, R.A. Microcomputers: a planning and implementation guide for librarians and information professionals. Oryx Press, 1983 (ISBN 0-89774-097-1)

Woods, L.A. and Pope, N.F. The librarian's guide to microcomputer technology and applications. Knowledge Industry (for the American Society for Information Science), 1983. (ISBN 0-87629-045-5).

SELECTING SOFTWARE
(for software intended for specific applications see under the application)

Armstrong, C.J. Micro-automation - the problems of selection. Electronic Library 2 (3) 1984. pp165-174

Bookshelf: an integrated, modular package for the smaller library. Vine (54) 1984. pp37-38

Burton, P.F. and Gates, H. Library software for microcomputers. Program 19 (1) 1985. pp1-19

Dyer, H. CALM: computer aided library management. Electronic Library 3 (4) 1985. pp242-248

Hunter, E.J. The ABC of BASIC: an introduction to programming for librarians. Bingley, 1982. (ISBN 0-85157-355-X)

Look, H.E. Evaluating software for microcomputers. Electronic Library 2 (1) 1984. pp53-60

Manson, P. Housekeeping systems for small libraries. Library Micromation News (7) 1985. pp11-16

Pegg, N. Micro Library: an integrated system for small to medium sized libraries. Vine (59) 1985. pp26-34

Tedd, L.A. Software for microcomputers in libraries and information units. Electronic Library 1 (1) 1983. pp31-48

Tenopir, C. Identification and evaluation of software for microcomputer-based in-house databases. Information Technology and Libraries 3 (1) 1984. pp21-34

Trevelyan, A. and Rowat, M. An investigation of the use of systems programs in library applications of microcomputers. British Library. 1983. (LIR Report no.12) (ISBN 0-7213-3017-8)

HARDWARE

Davis, C.H. Portable micros: potential for information management. Microcomputers for Information Management 1 (1) 1984. pp57-65

Goldstein, C.M. Storage technology: present and future. Microcomputers for Information Management 1 (2) 1984. pp79-93

Mason, R.M. Current and future microcomputer capabilities: selecting the hardware. Microcomputers for Information Management 1 (1) 1984. pp1-13

Torok, A.G. Ergonomic considerations in microcomputing. Microcomputers for Information Management 1 (3) 1984. pp229-250

ADMINISTRATION

Ben-Shir, R. Fast Inter Library Loans and Statistics: the second, enhanced release. Library Software Review 4 (3) 1985. pp132-138

Brooks, J.A. F.I.L.L.S. Fast Library Loans and Statistics. Electronic Library 3 (1) 1985. pp28-29

Corbett, P.K. Automating reference department functions via an electronic spreadsheet. Medical Reference Services Quarterly 3 (3) 1984. pp85-88

Desroches, R.A. and Rudd, M. Shelf space management: a microcomputer application. Information Technology and Libraries 2 (2) 1983. pp187-189

Diskin, J.A. and FitzGerald, P. Library signage: applications for the Apple Mackintosh and MacPaint. Library Hi-Tech 2 (4) 1984. pp71-77

Dowlin, K.E. and Hawley, B.G. The use of portable microcomputers for library inventory. Microcomputers for Information Management 1 (1) 1984. pp67-73

Ede, S.J. and Wheatley, M.L. The use of microcomputers in interlibrary lending. Interlending and Document Supply 13 (3) 1985. pp63-70

Evans, E.A. Microcomputers: an interlibrary loan application. Special Libraries 75 (1) 1984. pp17-27

Everhart, N. and Hartz, C. Creating graphics with "The Print Shop". Library Journal 110 (8) 1985. pp118-120

Gadsden, S.R. and Adams, R.J. The administration of interlending by microcomputer. British Library, 1984. (LIR Report no.30)

Marklund, K. Dimensional flowcharting to improve library performance. Microcomputers for Information Management 2 (2) 1985. pp113-118

Peasegood, A. and Stone, P. The model library: planning reshelving on a spreadsheet. Library Micromation News (5) 1984. p2

Potter, W.G. Modelling collection overlap on a microcomputer. Information Technology and Libraries 2 (4) 1983. pp400-407

Romaniuk, E. Analysis of survey results using a microcomputer. Information Technology and Libraries 4 (3) 1985. pp233-236

Shaw, D.S. Visicalc and the library acquisitions budget, in, Online 83 Conference Proceedings. 10-12 October, 1983. pp266-270

Stancil, I. and Harmeyer, K. A microcomputer application in information services evaluation, in, National Online Meeting. New York 12-14 April 1983. pp523-528

Witters, M. Interlibrary loans with a micro: clean and quick. Online 8 (6) 1984. pp53-61

CATALOGUES

Bocher, R. MITINET/Retro in Wisconsin libraries. Information Technology and Libraries 3 (3) 1984. pp267-274

Burton, P.F. Review of existing microcomputer systems for online access, in, Online public access to library files: conference proceedings. The proceedings of a conference held at the University of Bath, 3-5 September, 1984. Edited by Janet Kinsella. Elsevier, 1985. (ISBN 0-946395-18-7). pp27-44

Cheng, C-C. Microcomputer-based user interface. Information Technology and Libraries. 4 (4) 1985. pp346-351

Drake, V. and Smith, M.P. Retrospective conversion with REMARC at Johns Hopkins University. Information Technology and Libraries 3 (3) 1984. pp282-286

Lundeen, G. and Tenopir, C. Microcomputer-based library catalog software. Microcomputers for Information Management 1 (3) 1984. pp215-228

McNamara, F. OCLC's Cataloguing Micro Enhancer software. Library Software Review 4 (4) 1985. pp193-195

Pemberton, J.E. Cataloguing on a micro with LIBRARIAN. Library Micromation News (3) 1984. pp7-14

Schaub, J. CD-ROM for public access catalogs. Library Hi-Tech 3 (3) 1985. pp7-13

Taylor D. Progress with G&G Software: an update on Harper Adams Agricultural College library's computerisation programme. Library Micromation News (8) 1985. pp3-6.

Williams, B. Microcomputer based catalogs: DB Master and dBase II, in, Online 83 Conference Proceedings. 10-12 October, 1983. pp309-313

CIRCULATION CONTROL

Clark, A.J. Choosing a microcomputer-based circulation system for the College of Librarianship Wales Library. Program 20 (1) 1986. pp39-49

Davies, G. and Burden, M. Micro-aided systems at the University of Surrey. Vine (47) 1983. pp25-29

Evans, P. and Palmer, D. Biblio-Tech systems for college size libraries. Vine (57) 1984. pp13-19

Millar, P. and Cochrane, J. Administration of a reserve collection at Paisley College using dBase II. Program 19 (3) 1985. pp262-270

Rees, H. An online system for college libraries. Vine (50), 1983. pp42-46

Wood, L.R. An online microcomputer-based system at the University of Aston Library. Program 18 (1) 1984. pp66-82

Wood, L.R. A circulation control system on an ACT Apricot. Vine (57) 1984. pp4-12

INDEXING

Batty, D. Microcomputers in index language design and development. Microcomputers for Information Management 1 (4) 1984. pp303-312

Faulkner, R.W. dBase III and newspaper indexing. Library Software Review 4 (5) 1985. pp280-284

Harter, S.P. Authex: printed index production. Online Review 9 (6) 1985. pp451-453

Orna, E. Using a micro to help in thesaurus construction. MDA Information 8 (3) 1984. pp66-72

Raper, R. The business of computer-aided indexing. The Indexer 14 (2) 1984. pp118-119

Yerkey, A.N. A preserved context indexing system for microcomputers: PERMDEX. Information Processing & Management 19 (3) 1983. pp165-171

INFORMATION RETRIEVAL: GENERAL CONSIDERATIONS

Burton, P.F. Software off the shelf: in-house information with a micro. Aslib Proceedings 35 (9) 1983. pp335-345

Hjerppe, R. What artificial intelligence can, could, and can't, do for libraries and information services, in, 7th International Online Information Meeting, December 1983. pp7-25

MacDonald, J.S. Bibliographic databases on microcomputers: a series of demonstrations for staff and research students in the humanities. British Library, 1984. (BLR&D Report no.5844)

Noerr, P.L. and Bivins Noerr, K.T. A European view of micros for information management. Microcomputers for Information Management 1 (3) 1984. pp165-175

Rowbottom, M. First steps in choosing information retrieval packages. Library Micromation News (4) 1984. pp13-16

INFORMATION RETRIEVAL: SPECIFIC SYSTEMS

Armstrong, C.J. The use of a commercial microcomputer database management system as the basis for bibliographic information retrieval. Journal of Information Science 8 (5) 1984. pp197-201

Barlow, D. and Buttery, R. An integrated administration information system for National Health Service authorities, in, 7th International Online Information Meeting, December 1983. pp435-439

Betts, F.M. Quick Search Librarian fast but frustrating. Electronic Library 2 (3) 1984. pp153-155

Bordwell, S. dBase II - library use of a microcomputer database management system. Program 18 (2) 1984. pp157-165

Brooks, H. Mirabilis information retrieval system. Assignation 1 (1) 1983. pp23-27

Brunelle, B. The vendor's corner: the BRS/SEARCH System. Software Review 2 (4) 1983. pp245-254

Callow, M. Producing an index to legal periodicals in the Foreign and Commonwealth Office library using Cardbox. Program 19 (3) 1985. pp251-261

Felten, S.Y. and van Camp, A.J. Bibliotek: the bibliographic management software. Online 8 (6) 1984. pp47-50

Garten, E.D. Library Mate: database with keyword indexing. Electronic Library 2 (4) 1984. pp242-243

Green, K.E. and Whiting, J. Combined production of a current awareness bulletin and database on a microcomputer. Program 18 (4) 1984. pp298-307

Hensel, M. and Nelson, R. CDROM: dramatic key to information dissemination and use. Electronic library 2 (4) 1984. pp257-259

Institut fur Maschinelle Dokumentation. Description of the IV+V System software package. Microcomputers for Information Management 1 (3) 1984. pp191-197

Koll, M.B. Noreault, T. and McGill, M.J. Enhanced retrieval techniques on microcomputer, in, 5th National Online Meeting, 1984. pp165-170

Look, H. Monitor survey of the information industry: software for searching text files on micros. Monitor (29) 1983. pp5-9

Lundeen, G. and Tenopir, C. Microcomputer software for in-house databases: four top packages for under $2000. Online 9 (5) 1985. pp30-38

Mitlin, L.R. Bibliotek: designed for handling bibliographies. Electronic Library 2 (4) 1984. pp239-241

Montjar, B.D. Major league information retrieval on a little league system: BRS on a microcomputer system, in, 2nd National Conference on Integrated Online Library Systems, 1984. pp270-276

Noerr, P.L. and Noerr, K.T.B. Browse and navigate: an advance in database access methods. Information Processing and Management 21 (3) 1985. pp205-213

Palmer, R.C. dBase II: an introduction for information services. Pacific Information, 1984. (ISBN 0-913203-07-6)

Portable software packages for information handling. UNISIST Newsletter 12 (1) 1984. pp1-7

Portoghese, C. and Schrader, D.B. ZyINDEX: a powerful indexing and searching package. Electronic Library 3 (1) 1985. pp30-33

Portoghese, C.P. and Schrader, D.B. SIRE: information storage and searching. Electronic Library 3 (5) 1985. pp314-316

Rosenberg, V. The Personal Bibliographic System: a system for creating and maintaining bibliographies. Information Technology and Libraries 2 (2) 1983. pp184-187

Rowell, P.P. and Utterback, N. Scientific literature currency and organization using a microcomputer. Online 8 (1) 1984. pp18-21

Saffady, W. Data management software for microcomputers. Library Technology Reports 19 (5) 1983. pp449-596

Schulman, J-L. Video PATSEARCH: unique solution to a unique problem. International Journal of Micrographics & Video Technology 2 (1) 1983. pp21-25

Sonneman, S.S. The videodisc as a library tool. Special Libraries 74 (1) 1983. pp7-13

Sullivan, J. Using dBase II for bibliographic files. Online 9 (1) 1985. pp46-51

Tally, R. DB Master for the Apple. Small Computers in Libraries 4 (3) 1984. pp1-3

Tocatlian, J. and Rose, J.B. Unesco's General Information Programme and the application of information management software for microcomputers. Microcomputers for Information Management 1 (4) 1984. pp257-267

Town, W.G. Microcomputer-based graphical input and retrieval of chemical structure information, in, 8th International Online Information Meeting, December 1984. pp29-37

Townley, C.T. ODIN: a multifunction, multitype library microcomputer network. Information Technology and Libraries 3 (2) 1984. pp174-176

Vogt, S. Seekeasy. Electronic Library 2 (4) 1984. pp237-238

Yerkey, N. Ultrafile for predefined data. Electronic Library 2 (4) 1984. pp233-236

LOCAL AREA NETWORKS

Collier, M. Local area networks: the implications for library and information science. British Library, 1984 (LIR Report no.19). (ISBN 0-7123-3028-39)

Copeland, J.M. and Flood, S. Users and local area networks: opportunities for information transfer. Electronic Library 2 (4) 1984. pp273-277

Copeland, J. and Flood, S. Database software for a local area network. Library Micromation News (5) 1984. pp11-13

Levert, V.M. Applications of local area networks of microcomputers in libraries. Information Technology and Libraries 4 (1) 1985. pp9-18

ONLINE SEARCH ASSISTANCE: GENERAL CONSIDERATIONS

Atkinson, S.D. and Watkins, S.G. Managing database information. Online 9 (1) 1985. pp52-66

Foster, A. Extending the electronic library by downloading: its advantages and disadvantages. Library Association Record 86 (9) 1984. pp358-359

Griffiths, J-M. Microcomputers and online activities. Bulletin of the American Society for Information Science 10 (4) 1984. pp11-14

Hawkins, D.T. and Levy, L.R. Front end software for online database searching. Part 1: definitions, system features and evaluation. Online 9 (6) 1985. pp30-37

Jansen, A.A.J. Problems and challenges of downloading for database producers. Electronic Library 2 (1) 1984. pp41-51

Kesselman, M. Front-end/gateway software: availability and usefulness. Library Software Review 4 (2) 1985. pp67-70

Lucchetti, S.C. CAS Online: access via lower cost Tektronix terminal look-alikes. Online 8 (1) 1984. pp44-49

Mortensen, E. Downloading in online searching: a review of the literature, in, 8th International Online Information Meeting, December, 1985.

Mortensen, E. Downloading in office automation settings: benefits and restrictions, in, 5th National Online Meeting, 1984. pp235-242

Murr, K.R. After downloading: how to get the most out of your microcomputer, in, 5th National Online Meeting, 1984. pp243-246

Pratt, G.E.C. Using the microcomputer to simplify database access: designing interfaces to complex files. Journal of Inforamtion Science 10 (3) 1985. pp131-138

Roberts, S.K. The intelligent online terminal. Information Today 1 (4) 1984. pp28-30

Williams, P. Intelligent access to remote computer systems. Library and Information Research 8 (29) 1985. pp5-10

ONLINE SEARCH ASSISTANCE: SPECIFIC SYSTEMS

Arthur, A. Online searching with an Apple II micro on a local area network. Library Micromation News (6) 1984. pp5-8

Bean, C.S. Softerm and its use in online searching. Online 8 (5) 1984. pp52-56

Chapman, P. and Noerr, P. BLAISE CORTEX: a microprocessor system for libraries. Information Processing & Management 19 (2) 1983. pp77-81

Citroen, C.L. Multiuser microcomputer-assisted access to online systems, in, 7th International Online Information Meeting, December 1983. pp37-44

Ensor, P. and Curtis, R.A. Search Helper: low cost online searching in an academic library. RQ 23 (3) 1984. pp327-331

Janke, R.V. BRS/After Dark: the birth of online self-service. Online 7 (5) 1983. pp12-29

Ketchell, D.S. Online searching by microcomputer. Bulletin of the Medical Library Association 72 (4) 1984. pp370-372

Klausmeier, J. ERIC MICROsearch: searching ERIC on a microcomputer. Library Software Review 4 (2) 1985. pp63-66

Kolner, S. The IBM PC as an online search machine. Parts 1 - 5. Online 9 (1) 1985 - 9 (4) 1985.

Levy, L.R. Gateway software: is it for you? Online 8 (6) 1984. pp67-79

Marcus, R.S. An experimental comparison of the effectiveness of computers and humans as search intermediaries. Journal of the American Society for Information Science 34 (6) 1983. pp381-404

Marcus, R.S. Computer-assisted search planning and evaluation, in, Proceedings of the 46th ASIS Annual Meeting, 1983. Vol.20. pp19-21

Miller, R. Designing your own low cost front-end software. Online 9 (2) 1985. pp94-98

Mullen, A., Moller, E., and Blunck, M. Applications of PC 350 (DEC) for online searching evaluation and upgrading of results from patent and literature files, in, 8th International Online Information Meeting, December 1984. pp305-320

Nevins, K. Microcomputers in the mainframe environment, in, 8th International Online Information Meeting, December, 1984. pp321-330

Ryan, P.S. User friendly systems: the problem, the process, the progress at MGH Health Sciences Libraries, in, 8th International Online Information Meeting, December 1984. pp5-11

Stigleman, S. Instantcom: for online communications. Online Review 8 (6) 1984. pp539-542

Stout, C. and Marcinko, T. Sci-Mate: a menu-driven universal online searcher and personal data manager. Online (7) 5 1983. pp112-116

Wales, J.L. Using a microcomputer to access bibliographic databases: experience with Userlink software in the ICI Organics Division Information and Library Services Unit. Program 18 (3) 1984. pp247-257

Williams, P.W. A model for an expert system for automated information retrieval, in, 8th International Online Information Meeting, December 1984. pp139-149

SERIALS CONTROL

Carney, R. InfoTrac: an inhouse computer-access system. Library Hi-Tech 3 (2) 1985. pp91-94

Cole, S. and Hill, C. Automating library systems with PFS. Access: Microcomputers in Libraries 2 (4) 1982. pp11-14

Gadikian, R. Development of a periodicals list in dBase II. Library Software Review 4 (3) 1985. pp139-142

Schmidt, N.P. Choosing an automated serials control system. Serials Librarian 9 (1) 1984. pp65-86

Serials control from OCLC Europe. Vine (60) 1985. pp40-46

Vogel, J.T. and Burns, L.W. Serials management by microcomputer: the potential of DBMS. Online 8 (3) 1984. pp68-70

CASE STUDIES

Converse, W.R. Library microcomputer applications using DEC Rainbow 100. Small Computers in Libraries 4 (6) 1984. p5

Ertel, M. Apples in the Apple library - how one library took a byte. Online 7 (2) 1983. pp20-29

Harrison, D. and Batt, C. Microcomputers in public libraries. Public Libraries Research Group, 1983. (ISBN 0-9503801-5-6)

Holland, M.P. and Bean, M.H. The IBM Personal Computer in a large academic library, in, Online 83 Conference Proceedings. 10-12 October, 1983. pp118-123

Milliot, J. Micros at work: case studies of microcomputers in libraries. Knowledge Industry Publications, 1985. (ISBN 0-86729-117-6)

Rowlands, J. Compsoft DMS Delta: library applications at Scunthorpe Central Library. Vine (57) 1984. pp27-31

Williams, T. Microcomputer applications in a hospital library. Bulletin of the Medical Library Association 73 (2) 1985. pp207-210

Wray, S. Some notes on microcomputer applications in a library. Library Micromation News (6) 1984. pp3-5

OTHER APPLICATIONS

Bacsanyi, K. ELL: Education Library Locator. Education Libraries 9 (1/2) 1984. pp25,29

Regen, S.R. and Chen, C-c. Microcomputers: independence and information access for the physically handicapped. Microcomputers for Information Management 1 (4) 1984. pp285-301

Schoenly, S.B. A library tour and orientation program for small microcomputers. Software Review 1 (1) 1982. pp44-57

Snell, M.J. and Duggua, H. Microtext - electronic blackboard, expert system or teaching package. Library Micromation News (8) 1985. pp9-10

UTTL: What Should Users Expect from Information Storage and Retrieval Systems of the 1980's? CORP: Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ANN: Developments in the aerospace and defense information field and the information science field in general, are discussed. Unresolved problems, user and supplier related, in automatic indexing, fact retrieval, and input standardization are reviewed. The impact of technical and sociological changes on information services, now and in the future, is also addressed. For individual titles, see N82-23050 through N82-23060.
RPT#: AGARD-CP-304 ISBN-32-835-0305-8 AD-A111846 81/12/00 82N23049

UTTL: Automation pilot CORP: National Aeronautics and Space Administration, Washington, D.C. In its NASA Admin. Data Base Management Systems p 267-274 (SEE N83-18559 08-82)
ABS: An important concept of the Action Information Management System (AIMS) approach is to evaluate office automation technology in the context of hands on use by technical program managers in the conduct of human acceptance difficulties which may accompany the transition to a significantly changing work environment. The improved productivity and communications which result from application of office automation technology are already well established for general office environments, but benefits unique to NASA are anticipated and these will be explored in detail. 83/01/00 83N18576

UTTL: Gateway design specification for fiber optic local area networks CORP: Computer Technology Associates, Inc., Columbia, Md.
ABS: This is a Design Specification for a gateway to interconnect fiber optic local area networks (LAN's). The internetworking protocols for a gateway device that will interconnect multiple local area networks are defined. This specification serves as input for preparation of detailed design specifications for the hardware and software of a gateway device. General characteristics to be incorporated in the gateway such as node address mapping, packet fragmentation, and gateway routing features are described.
RPT#: NASA-CR-177823 NAS 1.26:177823 85/08/29 86N16991

UTTL: Project Gemini /U/ Quarterly status report for period ending 31 Aug. 1965 CORP: National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
RPT#: NASA-TM-X-61625 QSR-14 65/08/31 79N76686

UTTL: Information systems plan CORP: Corps of Engineers, St. Paul, Minn.
ABS: The purpose of this study is to analyze what information the St. Paul District uses, who needs to share data, what are the costs of information management, and who should be responsible for information management. This pilot project authorizes the District to demonstrate the feasibility of automated approaches through the acquisition and use of high technology equipment.
RPT#: AD-A157911 85/04/00 86N13227

UTTL: Microcomputer-controlled high-altitude data acquisition system CORP: Joint Publications Research Service, Arlington, Va. In its China Rept.: Sci. and Technol. (JPRS-CST-85-015) p 36 (SEE N86-11994 02-70) Transl. into ENGLISH from Jisuanji Shijie (Beijing), no. 7, 8 Apr. 1984 p 8
ABS: A new microcomputer controlled high altitude data acquisition system was developed. The system provides a new technique for data acquisition from China's astronomical, meteorological and other high altitude experiments and opens up new territory in microcomputer applications. This microcomputer controlled high altitude data acquisition system is made up of a Z80 single board computer, 10 K memory expansion board, and keyboard and display board which can collect 16 analog signals simultaneously, and through analog/digital conversion can convert external analog signals into digital signals then encode them in a certain form through program modulation and store them on audio cassette. The data is immediately retrieved from the tape and sent to the surface microcomputer system for data processing and analysis. 85/05/16 86N12000

UTTL: The electronic transmission of ESA invitations to tender - The EMITS system
AUTH: A/ALVISI, G.; B/DONDI, G.; C/KAHN, S.; D/OLDROYD, B. PAA: A/(ESA, Information Retrieval Service, Frascati, Italy); B/(ESA, Contracts Dept., Paris, France); C/(ESA, European Space Research and Technology Centre, Noordwijk, Netherlands)
ABS: The ESA is gradually shifting to full implementation of the EMITS (electronic mail invitation to tender)

system for issuing RFPs. Currently, 100-120 open RFPs are issued each year, drawing 3000-4000 responses. Hardcopy RFPs cost more than 16 MFr each year to print. The EMITS database is open to users of a freely acquired password, and yields lists of outstanding RFPs, contract texts, technical standards documentation and explanations of the database. It is expected (and hoped) that not only marketing managers but also technical personnel will access the EMITS. A microcomputer with a widely-used operating system and a serial interface are sufficient equipment to log on to EMITS, which displays data in both English and French. 85/08/00 86A12248

UTTL: Experimental use of online terminals in public libraries. Phase 2: Scotland
AUTH: A/ARMSTRONG, N.; B/DAVIES, R. CORP: Edinburgh City Libraries (Scotland).
RPT#: BLL-BLRDR-5683 81/11/00 83N72109

UTTL: Ingres to dBASE and financial spreadsheet program packages
AUTH: A/BAIRD, J. CORP: System Development Corp., San Diego, Calif.
ABS: The ingresdbase command provides support for exchanging user database files between two popular relational database management systems. Ingres and dBASE II databases may be related to or from their respective internal formats into a form suitable for transporting over standard ASCII data communication links. The command includes sufficient information to automatically re-create the database on the other machine with only modest user involvement.
RPT#: AD-A139626 NOSC-CR-223 84/02/00 84N25351

UTTL: A display translator for technical documents described in the Language for Representation of Mixed Documents (texts, graphics, facsimile)
AUTH: A/BELKHITER, N.
ABS: The SARDE project was initiated by the French agency CNET to develop a preliminary version of a Language for Representation of Mixed Documents for electronically archiving and displaying technical documentation in text, graphic and facsimile formats. The capabilities were to cover both research and industrial materials, including schematics and specifications and be coupled with computers for data analysis and telecommunications links. Attention was given to the user interface for selection and manipulation of different files. Remote users were to be able to access and treat the data in facsimile copies displayed on the CRT. Details of the language used to achieve the objectives are explored and compared to other efforts which have been directed to reach the same goals. 85/00/00 86A14156

UTTL: Techniques for integrated text and image processing and communication
AUTH: A/BERGMANN, B.; B/HORAK, W.; C/KUTSCHER, C.; D/POSTL, W.; E/SCHEITERER, E.; F/LOOBORSCHIL, W. CORP: Siemens A.G., Munich (West Germany). CSS: (Abteilung Systemarchitektur.)
ABS: Document preparation by an experimental text/image work station (Textfax) on the basis of a functionally structured, modular multimicrocomputer system is treated. Techniques were developed to process mixed text/image documents interactively in a single multifunctional work station and to mail them by means of a combined text-facsimile transmission instead of using a word processor, copier, pencil, scissors, glue, Teletex, and Telefax. On a raster display, A4-documents can be displayed with facsimile Group 3 resolution (1728 x 2288 pixels), black and white and gray-scale facsimiles can be shifted, turned, enlarged and mixed with text of multiple type and size. Printed images can be entered by an intelligent scanner and handgraphics by a tablet. The documents are locally printed and locally stored using compression codes.
RPT#: BMFT-FB-T-83-104 ISSN-0340-7608 83/06/00 84N11985

UTTL: A program for developing automated scientific-information processing in maritime economy
AUTH: A/CIUNDZIEWICKI, T.; B/PIOTROWSKI, T. CORP: Air Force Systems Command, Wright-Patterson AFB, Ohio. CSS: (Foreign Technology Div.) Transl. into ENGLISH from Techn. i Gospodarka Morska (Poland), v. 27, no. 4(310), Apr. 1977 p 205-206
ABS: The need for efficient means to acquire scientific and technical information is addressed. The shotcomings of the present automated systems are surveyed. Finally, basic requirements for further development of an automated scientific information system are outlined.
RPT#: AD-A135518 FTD-ID(RS)T-1525-83 83/11/17 84N18107

UTTL: Microcomputer networking in libraries. Report of a study visit to the United States 14th October 1983
AUTH: A/COLLIER, M. CORP: Polytechnic of Central London (England). CSS: (Dept. of Library Services.)
ABS: A study visit made to the United States of America by M.W. Collier is reported. The aim of the visit was to gather information on local area network developments

in the U.S. Information was gathered on network developments in libraries. A presentation at a conference in Colorado Springs was made on microcomputer networking in libraries. The visit is outlined in detail.
RPT#: BLRDR-5819 84/00/00 86N15976

UTTL: Data transfers among the HP-75, HP-86, and HP-9845 microcomputers
AUTH: A/CONNOR, D. P. CORP: Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
RPT#: AD-A139438 AFIT/CI/NR-83-91T 83/00/00 84N74289

UTTL: Integrated bibliographic information system: Integrating resources by integrating information technologies
AUTH: A/COTTER, G. A.; B/HARTT, R. W. CORP: Defense Technical Information Center, Alexandria, Va.
ABS: The Defense Technical Information Center (DTIC) is sponsoring the development of an integrated bibliographic information system. The prototype of this system, under development since April 1983, will be used to demonstrate the concept of an integrated library system combined with an intelligent gateway capable of querying and updating -- simultaneously -- more than one heterogeneous bibliographic data base (catalog). Queries and updates of any data base will be performed using a common command language, relieving the system user of the need to learn and master separate languages and procedures for each data base accessed. The development approach used, the information processing concepts and technologies investigated and selected for implementation in the prototype system, and the issues underpinning system implementation are described.
RPT#: AD-A157700 DTIC/TR-85/8 85/05/00 86N15211

UTTL: Data bases available at the National Bureau of Standards Library, 3rd edition
AUTH: A/CUNNINGHAM, D. CORP: National Bureau of Standards, Washington, D.C. CSS: (Library Div.)
ABS: An alphabetical listing of data bases available on line at the National Bureau of Standards (NBS) Library is listed by either acronym or full title of the data base. Other additional information includes description of the data base, period of coverage, producer(s), corresponding hard copy, principal sources and vendors. A general subject and a cross reference index to the data bases are also supplied.
RPT#: PB83-155986 NBSIR-82-2594 82/10/00 83N29132

UTTL: Communicating between the IBM personal computer and the Wang word processing system
AUTH: A/DOWNEY, R. M. CORP: Lawrence Livermore National Lab., Calif.
ABS: The steps for transferring documents to a Wang OIS word processor from an IBM Personal computer (PC) and for retrieving stored documents from the Wang are outlined. Hardware and software needed to connect the two systems are discussed, as well as the steps one should take in transferring a document.
RPT#: DE84-010423 UCID-19889-REV-1 84/03/15 84N30729

UTTL: The microcomputer in the acquisition environment
AUTH: A/ECUNG, M. CORP: Air Force Space Div., Los Angeles, Calif. In AF Business Research Management Center Proc. of the Fed. Acquisition Res. Symp. with Theme p 5-11 (SEE N84-23293 13-81)
ABS: Headquarters Space Division in Los Angeles took the initiative in adopting the microcomputer as a viable tool to improve overall operations. After a little better than 18 months there are over 200 terminals on station. Most are split between 4 and 8 user multiprocessor systems. Our primary goal in both microcomputer hardware and software acquisition is to stay away from proprietary products that can lock the user into a particular vendor for systems support and modification. The result of our November 1981 design decision was hardware configured around the Z80 microprocessor using the S-100 (IEEE-696) Bus. Standardized user interface was included by specifying a keyboard configuration of NASA'S Jet propulsion Laboratory design with 40 programmable function keys. Eight inch single side, single density floppy disk drives (IBM format 3740) were chosen because they represent the one industry wide standard in disk formating. Though most of this work was done in a Contracting office the conclusions are relevant to all. We feel the experience of our period of experimentation with Office Automation can aid other offices considering taking this course of action. We have had both positive and negative result with our effort, but the overall conclusion is that: (1) micro-computer office automation can not be avoided; and (2) we have only scratched the surface of its applications in the acquisition environment.
RPT#: AD-P002748 83/00/00 84N23295

UTTL: Development of a proposed standard for the exchange of scientific microcomputer programs
AUTH: A/FISCELLA, J. M. CORP: Ultracom, Inc., Del Mar, Calif.
ABS: The incompatibility problems encountered between different microcomputer and supermicrocomputer systems for the exchange of software are reviewed. It examines the causes of exchange incompatibility for some of the most widely used hardware and operating systems, with the aim of specifing a set of exchange standards. More than one standards set is required because of the diversity of operating systems and mass storage formats. The exchange standard developed include specifications of what types of files are to be included on the mass storage exchange medium, as well as a full description of the mass storage format (including medium, density, operating system, etc.). Three different exchange standard sets are recommended, all utilizing diskettes.
RPT#: PB84-157940 ULT-2002 83/11/00 84N24244

UTTL: Using digital simulation in the design of CAMAC systems
AUTH: A/GAMIN, P. V.; B/MORGUNOV, S. V.; C/SHAMASHOV, M. A. CORP: Joint Publications Research Service, Arlington, Va. In its USSR Report: Cybernetics, Computers and Automation Technology (JPRS-UCC-85-004) p 44-47 (SEE N86-15927 06-60) Transl. into ENGLISH from Mekhanizatsiya i Avtomatizatsiya Upravleniya (Kiev), no. 1, Jan. - Mar. 1985 p 46-48
ABS: Today most information-measuring systems use program-controlled CAMAC standard bus-module systems as linking devices when designing automated scientific research systems (ASNI) and when performing bench tests. These stems do not provide developed resources for debugging the programs, which sharply reduces the effectiveness of the process of design and debugging programs directly by means of the control microcomputer contained within the composition of the information-measuring system. On the other hand the diversity of the experiments that are carried out generates the need for creating new specialized CAMAC standard devices. The problems that arise in this case include those of determining the internal logical organization of the devices, time synchronization, studying reactions to external controlling influences and acquiring reliable programs for servicing such devices. The methods of simulational modeling are enjoying wide use as a way to solve these problems. In particular, a simulational model of an information-measuring system consisting of an emulator with a full configuration based on a YeS computer has been proposed as a design tool for the hardware and software base of an information-measuring system. 85/08/27 86N15934

UTTL: Implementation of a Distributed Computing Gateway (DCG) at Sandia National Laboratories
AUTH: A/HALL, R. C.; B/WIDMAN, D. H. CORP: Sandia National Labs., Albuquerque, N. Mex. CSS: (Scientific Network Design Div.)
ABS: Several modifications to the Sandia National Laboratories current scientific Central Computing Facility (CCF) are being made. These modifications include development of a Central Computing Network (CCN) and a dispersed Distributed Computing Network (DCN). It is necessary to develop a gateway between these two networks. This connection will permit distributed computers in the DCN to gain access to the data link, various support nodes, and the worker computers in the CCF. This presentation describes current efforts at Sandia National Laboratories to implement a VAX/VMS Distributed Computing Gateway (DCG) to serve as an interface node between the CCN and DCN. The functional characteristics of the DCG are identified. The hardware and software configurations are overviewed. Finally, security considerations pertinent to the implementation are addressed.
RPT#: DE82-020120 SAND-82-0490 82/06/00 83N12915

UTTL: Distributed Computing Gateway (DCG) conceptual design
AUTH: A/HALL, R. C.; B/HARVEY, D. A.; C/JENSEN, J. E. CORP: Sandia National Labs., Albuquerque, N. Mex. CSS: (Scientific Network Design Div.)
ABS: Several modifications are described for a scientific central computing facility (CCF). These modifications include development of a central computing network (DCN). It is necessary to develop a gateway between these two networks. This connection will permit distributed processors in the DCN to gain access to the data link, various support nodes, and the worker computers in the CCF. This document describes the conceptual design for the required gateway. It provides a general description of the hardware and software necessary to implement the gateway.
RPT#: SAND-81-0862 81/04/00 81N29838

UTTL: Study of a heterogeneous distributed microcomputer network using measured data and analytical/simulation models
AUTH: A/HAMMOND, J. L.; B/SCHLAG, J. H.; C/LAM, D. K.; D/MURRAY, D. N.; E/OREILLY, P. J. P. CORP: Georgia Inst. of Tech., Atlanta. CSS: (School of Electrical

Engineering.)
ABS: This study has been concerned with exploring the characteristics of a network with potential application in management information systems using both analytical/simulation models (developed in the study) and measured data obtained from the network models. The network used has been constructed in the School of Electrical Engineering at Georgia Tech with support from AIRMICS. A significant feature of the proposed program has been the approach of dealing with both experimental data from the physical network and results from analytical/simulation models. The completed study has been directed toward an enhanced understanding of heterogeneous, distributed microprocessor networks. Monitor equipment has been studied, installed and used to obtain experimental data on the operation of the network and analytical/simulation models were tailored to describe as accurately as possible the operation of the actual network. The results of the study are models which accurately describe network behavior. These models, which depend explicity on well-defined parameters, provide the facility to investigate alternative designs and to predict network behavior for many types of inputs, such as would be specified for particular management information systems.
RPT#: AD-A110069 E21-616 81/07/00 82N21959

UTTL: Intelligent gateway processors as integrators of CAD/CAM networks
AUTH: A/HAMPEL, V. E.; B/GARNER, B. L.; C/MATTHEWS, J. R. CORP: Lawrence Livermore National Lab., Calif.
ABS: The integration of dissimilar CAD/CAM hardware and software on local and geographically distributed networks is the major problem faced by large organizations today. We begin by examining the existing system for storage, retrieval, control, and distribution of design information at Lawrence Livermore National Laboratory (LLNL) and describe a new prototype Engineering Information System (EIS). We then discuss the Department of Energy neutral Data Exchange Format (DOE/DEF) for the sharing of mechanical drawings among DOE installations. Finally, we describe the potential role of the Intelligent Gateway Processor (IGP) as a transaction controller for engineering resources among contractors of the Air Force Logistics Command (AFLC). IGP capabilities include a unique interpreter-driven user interface which permits the installation and modification of resources and the translation of dissimilar data formats, commands, and protocols, in a unified manner while running non-stop.
RPT#: DE85-016287 UCRL-93115 CONF-851125-8 85/07/00

86N18025

UTTL: Fact retrieval in the 1980's
AUTH: A/HAMPEL, V. E. CORP: Lawrence Livermore National Lab., Calif. CSS: (Technology Information System Dept.) In AGARD What Should Users Expect from Inform. Storage and Retrieval Systems of the 1980's 36 p (SEE N82-23049 13-82)
ABS: Prevailing methodologies of fact retrieval in science and technology are reviewed. Numeric databases are shown to overtake in size and number the large bibliographic collections. The availability of low-cost intelligent computer terminals, micro- and minicomputers, is shown to make aggregation and post-processing of retrieval information from different sources readily possible. The user community is seen to shift from expert information specialists to the end-users of information. Techniques of tabular and graphical fact retrieval are examined. The prospects of fact retrieval by voice, touch screens, and videotext are discussed. The potential of two unusual three-dimensional display techniques, the computer-generated time-resolved integral hologram and the projection of virtual data images into space, are discussed. 81/12/00 82N23055

UTTL: TIS: An intelligent gateway computer for information and modeling networks. Overview
AUTH: A/HAMPEL, V. E.; B/BAILEY, C.; C/KAWAIN, R. A.; D/LANN, N. A.; E/MCGROGAN, S. K.; F/SCOTT, W. S.; G/STAMMERS, S. M.; H/THOMAS, J. L. CORP: Lawrence Livermore National Lab., Calif. CSS: (Technology Information System.)
ABS: The Technology Information System (TIS) is being used to develop software for Intelligent Gateway Computers (IGC) suitable for the prototyping of advanced, integrated information networks. Dedicated to information management, TIS leads the user to available information resources, on TIS or elsewhere, by means of a master directory and automated access procedures. Other geographically distributed information centers accessible through TIS include federal and commercial systems like DOE/RECON, NASA/RECON, DOD/DROLS, DOT/TIC, CIS, and DIALOG in the United States, the chemical information systems DARC in France, and DECHEMA in West Germany. New centers are added as required.
RPT#: DE83-017986 UCRL-53439 AD-A135916 83/08/00 84N14067

UTTL: Downloading and post-processing of bibliographic information with the TIS (Technology Information System) intelligent gateway computer

AUTH: A/HARRISON, I., JR.; B/HAMPEL, V. E.; C/KAWIN, R. A. CORP: Lawrence Livermore National Lab., Calif.

ABS: The TIS Intelligent Gateway Computer at the Lawrence Livermore National Laboratory provides authorized users automated access to other information centers, downloading of descriptive information and numerical data, and post-processing of bibliographic citations. Included is the aggregation of extracted information into topical files, the elimination of redundancy, and online review for the creation of annotated relevant sets. Post-processing of the reviewed information can be carried out by permutation of titles, abstracts, and descriptors with statistics (some in graphical form) of their single/multi-term expressions, statistical cross-correlation of data elements, and the creation of concordances and indexes. These tools give new insight into a subject matter or the characteristics of corporate/personal publications. These self-guided procedures can be performed online from remote terminals by telephone dial-up, WATS-lines, over TYMNET, and via the ARPA computer network. The TIS Intelligent Gateway Computer permits the linking of terminals among users. Information specialists and information requestors may jointly view and discuss the progress of an interactive search and its analysis from any location. Uncertain legal constraints by commercial information vendors limit the use of downloading and post-processing at this time to bibliographical information in the public domain, e.g. DOE/RECON.

RPT#: AD-A130800 UCRL-88119 82/09/09 84N11062

UTTL: Integrating micro-computers with a centralized DBMS: ORACLE, SEED AND INGRES

AUTH: A/HOERGER, J. CORP: Planning Research Corp., McLean, Va. In NASA, Washington NASA Admin. Data Base Management Systems, 1983 p 55-74 (SEE N84-21403 11-82)

ABS: Users of ADABAS, a relational-like data base management system (ADABAS) with its data base programming language (NATURAL) are acquiring microcomputers with hopes of solving their individual word processing, office automation, decision support, and simple data processing problems. As processor speeds, memory sizes, and disk storage capacities increase, individual departments begin to maintain "their own" data base on "their own" micro-computer. This situation can adversely affect several of the primary goals set for implementing a centralized DBMS. In order to avoid this potential problem, these micro-computers must be integrated with the centralized DBMS. An easy to use and flexible means for transferring logic data base files between the central data base machine and micro-computers must be provided. Some of the problems encounted in an effort to accomplish this integration and possible solutions are discussed. 84/04/00 84N21409

UTTL: CIMS: The Cartographic Information Management System

AUTH: A/INGRAM, J. R.; B/SIMMS, R. A. CORP: Inter-American Geodetic Survey, Fort Sam Houston, Tex.

ABS: The system described in this paper is a small microcomputer system being developed for the cataloging of graphical and nongraphical cartographic data describing the sources available and/or used in constructing maps and charts. The system is envisioned as a useful method to cartographic managers for reviewing sources belonging to an agency and determining what sources to use in a new or revised map product.

RPT#: AD-A108108 81/00/00 82N17571

UTTL: Automated programming systems for microcomputers discussed

AUTH: A/IVANOV, Y. V.; B/MASLENIKOV, Y. A.; C/CHEBYKIN, N. Y.; D/SHEBARIN, A. V.; E/SHTURTS, I. V. CORP: Joint Publications Research Service, Arlington, Va. In its Transl. on USSR Sci. and Technol.: Phys. Sci. and Technol., No. 63 (JPRS-73084) p 26-31 (SEE N79-21989 12-99) Transl. into ENGLISH from Upravlyayushchiye Sistemy i Mashiny (kiev), no. 5, Sep./Oct. 1978 p 39-42

ABS: A system for automating programming and debugging programs (SAP) for microcomputers is presented, and an actual SAP is described. There are two methods of program preparation for microcomputers which are described. One method uses a cross assembler and cross compiler, and the programs are debugged by a computer simulator. The other method uses special debugging systems which include a real microcomputer actual peripheral equipment and minicomputers to control the debugging operations, also the external memory. A combined method is recommended in which a microcomputer program is debugged initially by means of a program simulator, and the final debugging is accomplished in the system. 79/03/26 79N21991

UTTL: MICROLAN, file transfer program for microprocessors
AUTH: A/JASKOT, R. D.; B/HENRY, H. W. CORP: Naval Research Lab., Washington, D. C.
ABS: The age of automation has established its foothold in today's society. Computerization now affects almost everyone's job, and sharing of information is vital to successful job performance. Manual transfer of information is inefficient and prone to error, so another means is needed. One option is computer networking. Both Local Area Networks and long-haul networks presently exist, but they are either very expensive or hardware dependent. It would normally require a long lead time and high costs for the military to acquire an information transfer system. To provide a readily available, low-cost file transfer system, the authors developed an assembly language program named MICROLAN, which is written to work with three of the main microcomputer operating systems (CP/M-80, CP/M-86, and MS.DOS) and to take advantage of RS232 technology. MICROLAN was successfully tested for file transfer at up to 4800 baud, and suggestions have been included as to possible uses for MICROLAN in the military environment. Additionally, possible methods for upgrading MICROLAN are also included.
RPT#: AD-A156519 85/03/00 86N11900

UTTL: Report on the conversion of an on-line information retrieval system simulator for use on an ITT 2020 (Apple) microcomputer
AUTH: A/JOHNSON, D. K. CORP: British Library Lending Div., Boston Spa (England).
ABS: The programs were converted from a suite of existing programs in use on a Digico MTS16 minicomputer. The micro-based systems described can support a small data base of bibliographic records and this can be searched interactively using a simulation of the command language used by ESA-URS QUEST. This gives the simulator potential as a teaching aid in on-lines user education.
RPT#: BLL-BLRDR-5580 80/06/00 81N34092

UTTL: A guide to using the bibliographic features of the Integrated Library System (ILS)
AUTH: A/KING, S. G. CORP: Mitre Corp., McLean, Va. CSS: (Metrek Div.)
RPT#: AD-A135924 MTR-80W0074 LHNCBC-CR-80-01 NLM/DF-80/001A 80/03/00 84N73423

UTTL: EGP (Exterior Gateway Protocol) gateway under Berkeley UNIX 4.2
AUTH: A/KIRTON, P. CORP: University of Southern California, Marina del Rey. CSS: (Information Sciences Inst.)
ABS: This report describes an implementation of the Exterior Gateway Protocol that runs under the UNIX 4.2 BSD operating system. Some issues related to local network configurations are also discussed. The Exterior Gateway Protocol has been specified to allow autonomous development of different gateway systems while still maintaining global distribution of internet routing information. EGP provides a means for different autonomous gateway systems to exchange information about the networks that are reachable via them.
RPT#: AD-A148056 ISI/RR-84-145 84/10/00 85N17597

UTTL: Prototyping information systems on microcomputers - A design philosophy for engineering management
AUTH: A/KRAUSHAAR, J.; B/SHIRLAND, L. PAA: B/(Vermont, University, Burlington, VT)
ABS: A framework for engineering managers interested in designing and using information systems to satisfy management needs for decision making and strategy formulation is suggested. Guidelines for developing, maintaining, and controlling these systems are presented. Recent microcomputer hardware and software developments that make integrated systems feasible and desirable are discussed, and several methods for obtaining an integrated system are described along with their advantages and disadvantages. A particularly promising process for developing integrated systems is advocated and compared with the traditional system development process. A rationale for the success of this prototyping process is offered, and resource needs required by it are discussed. 85/02/00 85A29401

UTTL: The role of the TPA-70 gateway network in promoting transborder data flow of scientific information in an international setting
AUTH: A/LABADI, A.; B/SEBESTYEN, I. CORP: International Inst. for Applied Systems Analysis, Laxenburg (Austria).
ABS: An on line computerized international scientific and technical information network is described. It consists of node computers performing the usual network functions and time division multiplexers. It is based in Austria and has links with Tymnet, Telenet, Euronet, RPCnet, and Russian and Hungrian

networks. It provides concurrent terminal host communication, user user communication, user node operator communication, monitoring, remote training, saving of the traffic of any terminal, authorization control, day file (statistics) maintenance, and status reports.
RPT#: IIASA-WP-81-122 IIASA-RR-81-18 81/08/00 82N22914

UTTL: A systems development life cycle study of the information center
AUTH: A/LECHLEITNER, M. L. CORP: Naval Postgraduate School, Monterey, Calif.
ABS: End user computing has penetrated most large organizations in an uncontrolled fashion. The newness of the technology, the lack of management expertise, and the inability to gain corporatewide control under the traditional organizational structure have often resulted in inefficiency, incompatibility, and missed opportunities. One solution to this situation is the Information Center (IC). ICs are centralized coordination centers for end user computing and offer end user computer expertise. ICs may be any combination of consulting services, training services, mainframe computer terminals, or microcomputers. This thesis examines the IC concept from the viewpoint of the manager tasked with implementation and provides a methodology, the Systems Development Life Cycle, to evaluate and implement an IC. Each phase of the methodology is explained and some innovative ideas on IC implementation and operation are provided. Examples of past successes and mistakes are also presented.
RPT#: AD-A156977 AD-E950724 85/03/00 86N11079

UTTL: Conversion plan for the Army Library, Pentagon
AUTH: A/LOVELACE, J. CORP: Mitre Corp., McLean, Va. CSS: (Metrek Div.)
RPT#: PB81-128357 MTR-8032 NLM/DF-80/003E LHNCBC-80-07 AD-A135919 78/11/00 81N73733

UTTL: Design of an interface to an information retrieval network
AUTH: A/MENDOZA, J. D. CORP: Illinois Univ., Urbana-Champaign.
ABS: The use of computers for information retrieval has brought about a growth of databases (bibliographic, in particular) as well as an increase in the number of search service centers (SSCs) that make the databases accessible online. This thesis proposes an interface to these SSCs and databases to make the variabilities transparent to the user - an Automatic IRC. The Automatic IRC, aimed to be a full-service information center, provides the following services for the user: (1) assistance in the formation of the query; (2) assistance in the choice of relevant databases and location of SSC(s) that make the database(s) accessible at a low cost; (3) automatic dial-up and log-on to the SSCs and the databases; (4) translation of the user query into a format that can be processed by the SSC retrieval system; (5) post-processing of bibliographic citations from online searches (i.e., sorting, merging, eliminating duplicate citations and finishing the output); and (6) location, ordering and delivery of documents. 84/00/00 85N27750

UTTL: Unisist Newsletter, volume 12, no. 1, 1984
AUTH: A/MORALES, G. L. CORP: United Nations Educational, Scientific and Cultural Organization, Paris (France). CSS: (Div. of the General Information Programme.)
RPT#: ISSN-0379-2218 84/00/00 84N73722

UTTL: DETAM: Software system for process automation with microprogramming and decision tables
AUTH: A/NESTEL, S.; B/SCHAPER, K. CORP: Standard Elektrik Lorenz A.G., Stuttgart (West Germany). CSS: (Forschungszentrum.) In Kernforschungszentrum Karlsruhe G.m.b.H. INTERKAMA 1980 p 306-320 (SEE N82-20906 11-61)
ABS: The decision table support for microcomputers (DETAM) system was developed. The DETAM consists of a decision table preparation system which is processed on a minicomputer development system, and on a realtime operation program. The storage location and run time requirements are chosen between three alternative processing algorithms and planning, and optimization goals of predicted run time and storage device are explained. The DETAM enables automatic processing of fractional tasks in software development. 80/07/17 82N20933

UTTL: New technical information media
AUTH: A/NEUMANN-DUSCHA, I. CORP: Council for Scientific and Industrial Research, Pretoria (South Africa). CSS: (Foreign Language Service.) Transl. into ENGLISH from Monatsschrift fuer Brauwissenschaft (Berlin), no. 1, 1983 p 6-12
ABS: The development and use in the last few years of readily accessible online data banks are discussed, as well as already foreseeable further developments such as decentralized data processing by microcomputers; video readers and printers; and improved communications networks. These developments are now being applied to technical information in the brewing

industry and contributing to the more efficient use of such information.
RPT#: CSIR-TRANS-1731 83/00/00 84N32284

UTTL: Information retrieval
AUTH: A/NORTON, T. CORP: Royal Aircraft Establishment, Farnborough (England). In AGARD Manual of Doc. Pract. Appl. to Defence-Aerospace Sci. and Tech. Inform. Vol. 3 42 p (SEE N81-17950 08-82)
ABS: After a brief historical overview of information retrieval (IR), a model of an IR system is presented and described. The characteristics of conventional indexing systems are reviewed and shortcomings noted. The principles of postcoordinate indexing systems and examples of feature card and edge punched card systems with suggested applications are described. Problems of vocabulary control are discussed and suggestions on thesaurus construction and presentation are given. The use of computers to produce various types of indexes (KWIC, KWOC, and SLIC) is briefly described. The features of computerized dial up on-line information systems are discussed: equipment, telecommunications, file organization, search preparation and strategy, staff training, advantages and limitations of such systems, and future developments. An appendix outlines the principal features of specialized information centers. 80/10/00 81N17951

UTTL: Augmentation of a text retrieval system with an intelligent graphics terminal
AUTH: A/OLDING, S. E. CORP: National Physical Lab., Teddington (England). CSS: (Div. of Computer Science.)
ABS: A graphics system is described which is added on to an intelligent terminal and consists of a visual display unit, a microprocessor, and a storage tube display. The terminal is linked to the Scrapbook text retrieval system through a network. The command language, software, and applications are outlined.
RPT#: NPL-COM-86 77/01/00 78N18980

UTTL: Development of Minicomputers in an Environment of Scientific and Technological Information Centers (DOMESTIC): A minicomputer-based information handling software package
AUTH: A/OMER, Y.; B/SEELBACH, H. E. PAA: B/(KTS Informations-Systeme GmbH) CORP: National Center of Scientific and Technological Information, Tel Aviv (Israel).
ABS: DOMESTIC (Development of Minicomputers in an Environment of Scientific and Technological Information Centers) is a joint Israeli-German project for the application of minicomputers in information storage and retrieval. The DOMESTIC software package includes functions for online creation and updating of inhouse databases; assimilation of external databases; setting up, running and reformulating online database searches; viewing search results; printing the output in selected formats; and various tasks associated with the acquisition, cataloging and circulation phases of information center activities. The DOMESTIC system comprises at present programs for database management, online input of documents and thesaurus creation and maintenance, search and interactive dialog modules, a print generator, a library management module and various batach input modules.
RPT#: BMFT-FB-ID-82-005 ISSN-0170-8996 82/10/00 83N21809

UTTL: Predictions of satisfaction with automated library circulation systems
AUTH: A/OSBORNE, L. CORP: Pittsburgh Univ., Pa.
ABS: This research investigates other than objective operational parameters, which affect satisfaction with automated library circulation systems. Libraries which had implemented or ordered systems as of June 1981 formed the population questionnaires were sent to each of these 256 libraries asking that the chief executive office department head who supervised circulation, and a person who checks books out on a day to day basis respond. Responses were received from 467 individuals. Variables included the extent to which an idealized planning process developed as part of the research, was followed; the degree of disconfirmation of expectations reported by the respondents (i.e., the degree to which the system did not perform as expected), the reported satisfaction level with the system, and other descriptive and demographic variables. It was found that disconfirmation of expectations was the most important determinant of satisfaction among the variables studied, generally accounting for more than 25 percent of total variance in satisfaction. 83/00/00 84N33259

UTTL: Microcomputers. Part 2: Telecommunication applications, volume 3. Citations from the Engineering Index Data Base
AUTH: A/REED, W. E. CORP: National Technical Information Service, Springfield, Va.
ABS: The bibliography of worldwide research literature cites studies on telecommunication applications of microcomputers. telephone, data transmission, teleprinters, facsmile communications, and

communications controllers are among the applications cited.
RPT#: NTIS/PS-79/0728/0 NTIS/PS-78/0613 NTIS/PS-77/0328 NTIS/PS-76/0203 79/07/00 79N33870

UTTL: Integration of new technology in Army libraries, appendices
AUTH: A/REID, J.; B/STRAIN, P.; C/LINSLEY, A.; D/GRIFFITHS, J. M.; E/PALMOUR, V. E. CORP: Damans and Associates, Inc., Gaithersburg, Md.
ABS: The 1976 Study of US Army Libraries recommended that the technical processing functions of each Army library be consolidated or centralized at the installation level. Integration of New Technology in Army Libraries determined the feasibility of installation-level networking of technical processing activities, and develops the means through which new technology can be integrated into Army Libraries. Site visits to Fort Belvoir, Virginia and Aberdeen Proving Ground, Maryland, libraries gathered information that detailed current library technical processing operations for monographs, serials, and technical reports. Library automated turnkey systems and alternative configurations for consolidation were examined. Based on gathered data, a cost model was developed and applied to decentralized, installation-level, and command-level technical processing. Recommendations include projected organizational, staffing, and budget requirements, and an implementation plan for installation-level consolidation.
RPT#: AD-A125984 82/07/02 83N30308

UTTL: Enhanced UK teletext: Experimental equipment for high-quality picture coding and other enhancements
AUTH: A/RILEY, J. L. CORP: British Broadcasting Corp., London (England). CSS: (Research Dept.)
ABS: The construction of a pair of microcomputer-based units which will serve as a research tool in engineering teletext enhancements, one unit a transmitter and the other a receiver in a closed-circuit teletext transmission is described. The microcomputer system and frame store design is basically similar to that currently used by Logica in the Flair electronic graphics equipment. Considerable effort was devoted to the development of software handling. The units are equipped with a CP/M operating system, which is already widely known. This greatly simplifies the management of files and includes compiling routines and a software debugging tool. Software is being prepared in PASCAL. Routines were developed to receive, generate, edit and transmit teletext in its present form. Early attention was given to demonstrating that picture teletext is feasible through a crudely-coded slow-scan television system. An acceptable sampling structure for these pictures and optimizing the coding of data to fit in with a hierarchy of coding embracing other aspects of enhanced teletext, for example, geometric drawing, electronic painting and telesoftware are addressed. A high quality character font was incorporated to improve the display of text.
RPT#: BBC-RD-1983/7 83/07/00 83N33008

UTTL: A telex gateway for the Internet
AUTH: A/SIEKER, F. M. Z. CORP: Massachusetts Inst. of Tech., Cambridge. CSS: (Lab. for Computer Science.)
ABS: The design of a gateway connecting one of the networks of the MIT Laboratory for Computer Science to the telex network is discussed. A description of the telex network is given. The relationship of the gateway to other resources of the network environment is considered to obtain directions for the implementation of new resources. The implementation of the gateway on the UNIX operating system outlined.
RPT#: AD-A121597 MIT/LCS/TM-222 82/05/00 83N17783

UTTL: Assurance Program for Remedial Action (APRA) microcomputer-operated bibliography management system
AUTH: A/STENNER, R. D.; B/WASHBURN, D. K.; C/DENHAM, D. H. CORP: Pacific Northwest Lab., Richland, Wash.
ABS: Pacific Northwest Laboratory (PNL) provided technical assistance to the Office of Operational Safety (OOS) in developing their Assurance Program for Remedial Action (APRA). The APRA Bibliography Management System (BMS), a microcomputer-operated system designed to file, locate and retrieve project-specific bibliographic data, was developed to manage the documentation associated with APRA. The BMS uses APRABASE, a PNL-developed computer program written in dBASE II language, which is designed to operate using the commercially available dBASE II database software. This document describes the APRABASE computer program, its associated subprograms, and the dBASE II APRA file. A User's Manual is also provided in the document. Although the BMS was designed to manage APRA-associated documents, it could be easily adapted for use in handling bibliographic data associated with any project.
RPT#: DE85-008763 PNL-5527 85/06/00 86N16155

UTTL: A new generation of ASPID information retrieval systems
AUTH: A/STOLYAROV, G. K.; B/GRIGYANETS, R. B.; C/KVACHUK, K. P. CORP: Joint Publications Research Service, Arlington, Va. In its USSR Report: Cybernetics, Computers and Automation Technology (JPRS-UCC-85-005) p 25-27 (SEE N86-16924 07-60) Transl. into ENGLISH from Upravlyayushchiye Sistemy i Mashiny (USSR), no. 2, Mar-Apr. 1985 p 126.124
ABS: The Automated Keyword Information Retrieval System (ASPID) is the Soviets' continually developing family of information management software. It operates on large-scale, mini, and micro computers and is the largest system link for processing scientific technical, design, and organizational management information. Two new members of the ASPID family, ASPID-5/YeS and ASPID-7/SM, address the need for local and locally-distributed problem oriented information systems. Research at the laboratory for software systems at the Institute of Mathematics Academy of Sciences of the Belorussian SSR (AN BSSR) was completed in June 1984 for two new interactive document data retrieval systems, ASPID-5/YeS which runs on ES computers and ASPID-7/SM which runs on SM computers. ASPID-5/YeS was designed to create interactive document information retrieval systems on the ES computers and utilizes the newest domestic and foreign achievements in information system software. The system provides input, data base formatting, integrated storage, and keyword search and retrieval of free-form text as well as highly structured information. A number of the system's features are listed. 85/08/28 86N16928

UTTL: Microcomputer standardization program at Lawrence Livermore Laboratory
AUTH: A/STRIPEIKA, A. J. CORP: Lawrence Livermore National Lab., Calif.
RPT#: UCID-17524 77/07/20 80N72744

UTTL: The teaching of online cataloguing and searching and the use of new technology in U.K. schools of librarianship and information science
AUTH: A/TEDD, L. A. CORP: British Library Lending Div., Boston Spa (England).
ABS: In late 1979, the 16 schools of librarianship and information science in the U.K. were surveyed on their teaching of online cataloguing and searching as well as their use of new technology, such as microcomputer systems, intelligent terminals, viewdata systems and so on. The results are described along with details of work in this area in seven of the schools. Recommendations for further work in this area are included.
RPT#: BLL-BLRDR-5616 ISBN-0-905984-67-6 ISSN-0308-2385 81/04/00 81N34082

UTTL: On line astronomical image processing using microcomputers
AUTH: A/THOM, C. CORP: Centre d'Etudes et de Recherches Geodynamiques et Astronomiques, St. Vallier de Thiey (France). CSS: (Observatoire du Calern.) In ESA Colloq. on Kilometric Opt. Arrays in Space p 153-154 (SEE N86-11096 01-89)
ABS: A microprocessor based system for reducing images on a large astronomical interferometer was built for use as an autocorrelator. It consists of three standard VME boards (two CPU boards and a graphic visualization controller) and a board built for image acquisition. The CPU 1 is a 128 kbyte, MC 68000 with 8 MHz clock. It does photon centroiding and image cleaning; CPU 2 is a 512 kbyte, MC 68000 with 10 MHz clock. It does image autocorrelation and integration, but can be adapted to user needs. The graphic controller is 256 x 256 pixels in 16 colors. Images are stored in two fast flip-flop RAMs to allow the processor to work on the last image without interference with acquisition of the next one. 85/04/00 86N11121

UTTL: Demonstration project: Putting the bioastronautics data book on line
AUTH: A/TRAVIS, I. L. CORP: NASA Scientific and Technical Information Facility, Baltimore/Washington International Airport, Md. 21240.
ABS: The possibilities for prototyping electronic document designs using existing microcomputer software are considered. An initial prototype of a hierarchically structured design that includes both text and graphics from a section of the Bioastronautics Data Book are considered.
RPT#: NASA-CR-178424 NAS 1.26:178424 85/06/00 85N30659

UTTL: Microprocessor/microcomputer based design in telecommunications systems
AUTH: A/TSENG, J. H. W. CORP: Southern Methodist Univ., Dallas, Tex.
ABS: The application of microprocessor in some selected telecommunications areas is discussed. Current technology is examined. General design considerations are described. The basic design techniques in switching are illustrated by a medium size, microprocessor-based intercommunication system. Hardware configurations are provided and software

algorithms are developed. Various alternatives are analyzed. An error detection in an ARQ system and an end-to-end encryption design, both using a microprocessor, are presented with implementation. Possible refinements are noted. A telecommunication system utilizing microprocessors as computing devices or intelligent terminals at various nodes is discussed. Hardware and software implementations are given. 78/00/00 79N23670

UTTL: Development of IS2100: An information systems laboratory
AUTH: A/WITTEN, C. S. D. CORP: Naval Postgraduate School, Monterey, Calif.
ABS: On the premise that fundamental concepts and uses of microcomputers can be better taught in a hands-on environment, the Administrative Science Department Instructional Laboratory was established. IS 2100, an Information Systems Laboratory uses these facilities to reinforce material taught in the first two quarters of the Computer System Management Curriculum. Its purpose and objective is to develop computer literacy and introduce the student to microcomputers and the facilities of the developing laboratory. This thesis is the report of the development of IS 2100 as first taught during Winter 1985.
RPT#: AD-A156848 AD-E301723 85/03/00 86N10797

UTTL: The iNet Gateway trial
AUTH: A/WOLTERS, P. H. CORP: National Research Council of Canada, Ottawa (Ontario). CSS: (Automated Systems and Networks.) In AGARD The Appl. of New Technol. to Improve the Delivery of Aerospace and Defence Inform. 11 p (SEE N84-21425 11-82)
ABS: The iNet Gateway is an intelligent network concept developed by the Computer Communications Group (CCG) of the TransCanada Telephone System (TCTS). iNet has evolved in recognition of the requirement for more universal accessibility to information providers and other computer based service. The iNet Gateway is designed to simplify the process of gathering, using and communicating information by offering a sngle point of access to satisfy the information needs of a user. In order to test the concept of intelligent networking a one year field trial is being conducted. The purpose of the trial is to provide the business and information communities with a single point of access to a great variety of computer systems including international, national and local networks as well as offline services provided by information specialists or intermediaries. The trial is expected to further define the requirements for value-added network services. 83/12/00 84N21427

UTTL: Flexible disc storage sytem for a microcomputer
AUTH: A/WONG, R. K. H. CORP: New South Wales Univ., Kensington (Australia). 79/00/00 83N70865

UTTL: A study of the extent of automation in small college libraries and relationships of attitudes of library directors toward it
AUTH: A/YOTHER, L. W. CORP: Connecticut Univ., Storrs.
ABS: Library automation in small college libraries is a relatively new application for computers. Little has been known about the extent of library automation already in place, the attitudes of library directions toward it, or the relationships of these attitudes to the extent of automation in libraries. This has been especially true for small academic libraries with fewer than 100,000 volumes. This study surveyed a random national sample of 175 such libraries to determine the extent of automation in place, the attitudes of library directors toward automation in general, and the relationships of these attitudes and selected variables to the extent of automation in small libraries. The data on extent of automation were subjected to analysis of variance and stepwise multiple regression, to determine the relationship between the degree of library automation and size of collection, institutional control, background of directors and staff members, and attitudes toward library automation held by library directors. A .05 level of significance was applied to all resulting values. 84/00/00 84N33260

UTTL: Gateway testing techniques
AUTH: A/ZENG, H. X.; B/RAYNER, D. CORP: National Physical Lab., Teddington (England). CSS: (Protocol Standards Group.)
ABS: The transverse method and the loop-back method were used to test two commercially available Yellow Book gateways. The separation method has more severe shortcomings and was excluded from practical investigations. The first two methods are suitable for testing open systems interconnection network relays. Experience suggests that the effort required to test gateways can be shared with that required to test end-systems, e.g., by sharing the encoder decoder and part of the test driver with an active tester for end-systems. However, the two testing systems differ from each other because of different testing configurations. For the same reason, the definition of pairs of tests for gateways would benefit from a

different test specification language. The NBS end-system testing approach uses the definition of pairs of tests and may also benefit from use of a test pair specification language.

RPT#: NPL-DITC-49/84 ISSN-0262-5369 84/10/00 85N18621

AGARD Lecture Series No.149 Advisory Group for Aerospace Research and Development, NATO THE APPLICATION OF MICROCOMPUTERS TO AEROSPACE AND DEFENCE SCIENTIFIC AND TECHNICAL INFORMATION WORK Published October 1986 124 pages The development and widespread distribution of the low-cost, reliable, general purpose microcomputer has radically influenced expectations of the scope and economics of computer applications in information work. The speakers in this Lecture Series draw on a wide range of practical experience to present studies of what is now P.T.O.	AGARD-LS-149 Libraries Information systems Aerospace engineering Research Computers

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